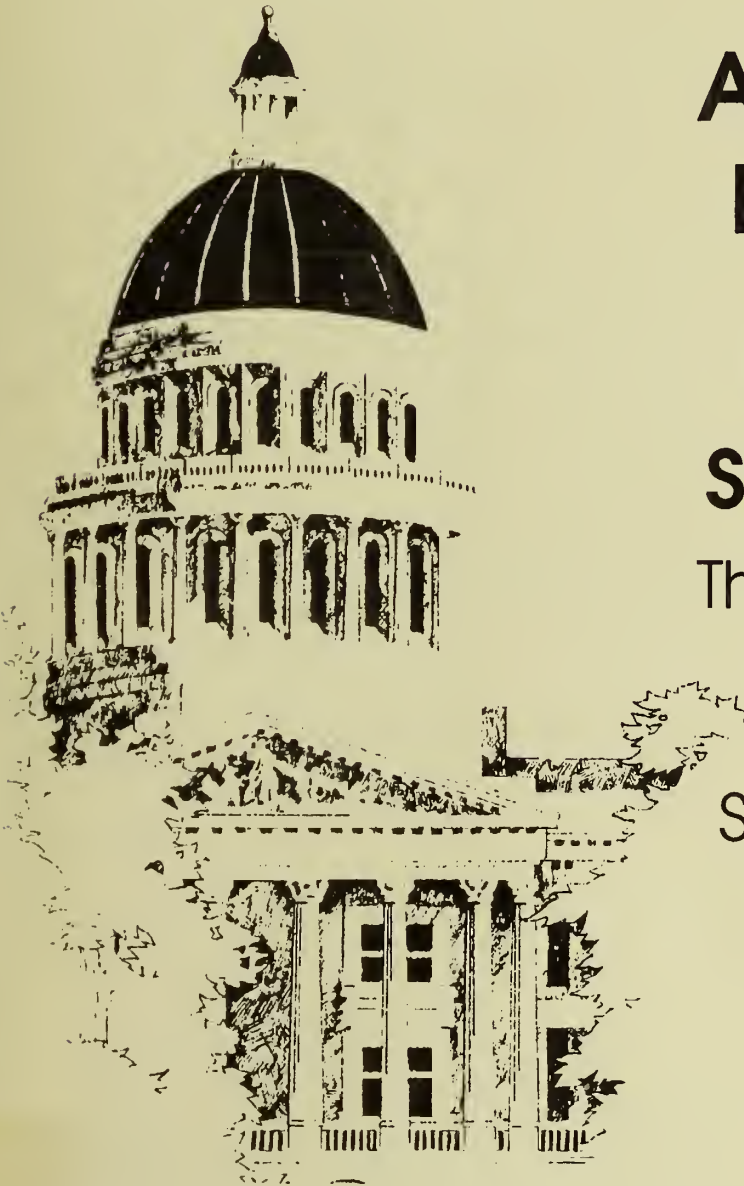




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# AN OUNCE OF PREVENTION: Planning & Regulating for Seismic Hazards

The Summary Report  
from the Interim  
Hearing of the  
Senate Committee  
on Housing and  
Land Use

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Housing and Land Use

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CHAIRMAN

**AN OUNCE OF PREVENTION:  
Planning & Regulating for Seismic Hazards**

**The Summary Report from the Interim Hearing**

**Wednesday, October 16**

**San José City Hall, Room 106  
801 North First Street  
San José, California**

REF 363.3495 C1275o

California. Legislature.  
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An ounce of prevention :  
planning & regulating  
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## **AN OUNCE OF PREVENTION: Planning & Regulating For Seismic Hazards**

On Wednesday, October 16, 1996, the Senate Housing and Land Use Committee held an interim hearing at the San José City Hall on seismic hazard planning and regulations. Three State Senators and an Assemblymember learned from the testimony of safety experts, planners, building officials, and government researchers. The Committee's hearing began at 10:05 a.m. and continued until 1:00 p.m. About 40 people attended the hearing. The four state legislators who attended the hearing were:

Senator Byron D. Sher, Committee Chairman  
Senator Diane Watson, Committee member  
Senator Alfred E. Alquist  
Assemblyman Dominic L. Cortese

This summary report contains the Committee staff's explanation of what happened at the hearing [see the **white** pages], reprints the briefing paper that the staff wrote for the Committee [see the **blue** pages], and reproduces the witnesses' written materials [see the **yellow** pages].

### **STAFF FINDINGS**

Any attempt to distill three hours of presentations and discussions into a few findings must gloss over important details. But after carefully considering the witnesses' comments and the written materials, the Committee's staff identified 10 key findings:

- Tens of thousands of San Francisco Bay Area residences will be uninhabitable after the next, inevitable major earthquake. South Bay businesses, officials, and residents need to take heed.
- Widespread residential damage after a major earthquake will keep employees from their jobs. When Bay Area companies lose productivity, California's economy will suffer.
- Public agencies have improved emergency rescue programs. But public programs to encourage private property owners to strengthen their buildings with seismic retrofit projects are inadequate.
- Costly residential rebuilding after an earthquake can be reduced if insurance companies, residential lenders, and public officials cooperate to offer economic incentives to strengthen buildings.
- Economic incentives --- like insurance discounts and tax credits --- can speed the acceptance of mitigation measures to reduce residential damage.
- Even modest investments in strengthening vulnerable buildings are cost-efficient. State budget managers should view mitigation as a long-term investment not just a current year expense.

- State officials can accurately map seismic hazards but the state's production of the seismic hazard zone maps lags. Faster production of these maps will help private firms and public officials identify and mitigate risks. Deaths, injuries, and property damage can be avoided.
- Better information can produce more accurate earthquake insurance ratings. The California Earthquake Authority, insurance companies, and lenders should use new research and existing data to identify seismic hazards more precisely. State officials should make this information more available to the CEA and private companies.
- Local officials can combine new information about seismic hazards with the traditional techniques of land use planning and building standards to mitigate residential damage. Few do.
- Public agencies learn and adapt after disasters. Expert advisors have identified useful steps to mitigate residential damage and speed recovery efforts. To implement these changes, political leaders must set clear priorities for the 1997-98 legislative session.

## THE WITNESSES

A dozen people spoke at the Committee hearing, most of whom presented written materials that appear in the **yellow** pages.

Honorable Trixie Johnson  
Vice Mayor, City of San José

Rich Eisner, Regional Administrator\*  
State Office of Emergency Services

Traci Stevens, Deputy Secretary\*  
State and Consumer Services Agency

Chuck Real, Supervising Geologist\*  
California Division of Mines and Geology

Honorable Charlotte Powers, President  
Association of Bay Area Governments

Jeanne B. Perkins, Earthquake Program Manager\*  
Association of Bay Area Governments

Professor Mary C. Comerio, Architecture Department\*  
University of California, Berkeley

Michael Flores, Senior Planner  
City of San José

Andrew Adelman\*  
California Building Officials

Diane Colburn, Legislative Advocate\*  
Personal Insurance Federation of California

Dr. Frances Winslow, Emergency Services Director  
City of San José

Leo Ruth, C.E.

In addition to these witnesses' comments, the Committee received written advice from Peter Chamberlin, Inyo County's Planning Director, and Robert J. Kuntz, President of the California Engineering Foundation. Their written materials appear in the yellow pages.

## INTRODUCTORY REMARKS

**Senator Sher** opened the hearing by recalling that the Committee was holding its hearing on the eve of the seventh anniversary of the Loma Prieta Earthquake. That 1989 disaster "reminded us that the long cycles of geologic time are punctuated by shocks to our daily lives." Sher was teaching a class at the Stanford Law School when the disaster hit. The Loma Prieta Earthquake gave us, the Senator said, "The kind of excitement that most of us can do without."

He outlined two main themes for the Committee's hearing. "The first question before us today is 'What have we done since Loma Prieta?'" Senator Sher said. He added that the "second theme is the grim topic of residential damage caused by earthquakes." Sher continued, "Besides the personal tragedies, I worry about the harm to our region's economy. How will private employers like Silicon Valley manufacturers and service firms rebound if their workers have nowhere to live?"

Senator Sher then invited other legislators to add their own views.

**Senator Alquist** noted that in trying to enact seismic safety bills, he continually encountered the problem of the "eternal optimism of the American people. They may not be willing to pay for that 'ounce of prevention.'" Alquist told the story of his attempt to create the Seismic Safety Commission. Governor Ronald Reagan vetoed Alquist's first bill, introduced after the 1971 San Fernando Earthquake. But a second attempt succeeded the following year, Alquist said, after another earthquake rocked the sleeping Governor from his bed.

Turning to the issue of local planning for seismic hazards, Alquist praised the communities in the 13th Senate District which he represents for having up-to-date safety elements in their general plans. Referring to a table in the briefing report [see the blue pages], Alquist said that he was pleased that local officials took the issue seriously.



San José Vice Mayor **Trixie Johnson** then welcomed the state legislators to City Hall which she called "an appropriate location" for a "most fitting" hearing on the anniversary of the Loma Prieta Earthquake. Johnson thanked the Committee for "focusing on planning and prevention" efforts. She told them that San José officials had been working on "simple, basic things" like undergrounding the overhead utility lines in front of fire stations, making emergency rescue work safer and more reliable. You are "focusing on exactly the right thing," Johnson told the legislators.

## LOMA PRIETA PLUS SEVEN

**Rich Eisner** is the San Francisco Bay Area Regional Administrator for the State Office of Emergency Services (OES), the official who will be responsible for coordinating rescue efforts after the next major earthquake. Eisner noted that it was his curious fortune to be in San Francisco during the Loma Prieta Earthquake and in Los Angeles for the Northridge Earthquake. He submitted written comments from OES Director Richard Andrews [see the yellow pages] and then used slides to illustrate his own testimony.

Loma Prieta was the first major urban earthquake in modern times in California. Although public officials learned many lessons about rescue efforts, there is still no solution to the problem of housing after a major earthquake. Officials have estimated damage costs from the Loma Prieta Earthquake at \$5.9 billion but the full cost will not be known for another decade, after all repairs are complete. Of the 11,000 claims for damage to public facilities, 7,000 claims are still outstanding. Further, the economic costs from the disaster will be at least as large as the direct damage costs.

The lack of preparation for rebuilding led to delays after the Loma Prieta Earthquake in design, engineering, and code enforcement, especially for older buildings. Although generous, federal reimbursement policy does not cover the costs of rebuilding structures to California's higher standards. Local officials' problems compounded when they had trouble financing the "local match" needed to attract federal reimbursement dollars. The recovery period coincided with an economic recession that squeezed local budgets.

State officials boosted spending on the state's own earthquake preparedness programs after the Loma Prieta Earthquake, allowing OES to produce a wide range of safety materials and video tapes to help Californians prepare for earthquakes. Eisner shared some of these materials with the legislators. But the recession of the 1990s resulted in pressures on the state budget and funding did not remain at the higher levels.

In a dialogue with legislators about state and local preparations for emergency rescue services, Eisner declared that OES and local agencies are in "better shape than we were in Loma Prieta." Officials no longer plan for the last emergency which had been the practice before 1989. That tragedy "turned us around" he said, and officials now plan for future disasters. Eisner described the advances in organized urban rescue task forces, satellite based communications, standard emergency management practices, and improved coordination among state, regional, and local efforts. The next major practice of these preparations in the Bay Area will be in April 1997.

## "TURNING LOSS TO GAIN"

The new Executive Director of the Seismic Safety Commission is **Richard J. McCarthy** who explained the four fundamental goals in Turning Loss to Gain, the report that the Commission prepared after the Northridge Earthquake:

- Make seismic safety a priority.
- Improve the quality of construction.
- Reduce the risk from seismically vulnerable structures.
- Improve the performance of lifelines.

In both oral and written testimony [see the **yellow** pages], McCarthy conceded that the Commission presented Turning Loss to Gain without assigning priorities to the 168 recommendations. The Commission is currently setting priorities as part of its effort to produce a third edition of California at Risk, the report required by Senator Alquist's earlier legislation. "We're taking a different approach" which will be "policy-driven," said McCarthy. Federal officials recognize California at Risk as the state's mitigation plan and FEMA will help pay for recovery efforts if they are mentioned in the report. Although other states use the report to guide their own efforts, "it's flawed and that's why we're improving it," he said. McCarthy invited the Committee to participate in a "cooperative effort" to set priorities for the next legislative session, to help legislators decide which bills to carry. The draft report will be available in November and the Commission should act in December. The Commission plans to publish the new, third edition in April 1997, to coincide with Earthquake Awareness Month.

Aware that local officials resist new state mandated programs and because new state costs worry the State Department of Finance, McCarthy said that the Seismic Safety Commission created a "subcommittee on economics" to study economic incentives with financial professionals and state budget managers. The Department of Finance worries about the effect of policy changes on the proposed state budget, not the effects on the state budgets in the fiscal year when the next earthquake occurs and then in future fiscal years. Spending state money in a current budget year may hold down recovery costs in future years. "We need to have a dialogue with the Department of Finance," McCarthy said, over the land use planning recommendations like those in SB 1874 (Alquist, 1996).

Responding to a question from **Senator Sher**, McCarthy said that there was little opposition from local officials to the Alquist bill's proposed mandates but Finance opposed SB 1874 which would have required cities and counties to regularly review the safety elements in their local general plans.

Returning to a point raised earlier by Senator Alquist, McCarthy repeated his hope that federal and state officials would relocate the National Center for Earthquake Engineering Research from New York to California. McCarthy responded to Senator Sher's question about Congressional



plans to slash funding for the U.S. Geologic Survey's earthquake research programs in Menlo Park, saying that Congress dropped the proposal to dissolve USGS but cut the agency's budget.

**Senator Alquist** reminded his colleagues that the destruction of the Veterans Administration hospital in the 1971 San Fernando Earthquake led to his bill that set higher standards for hospital safety. Nevertheless, local officials opposed his attempts to set higher standards for "essential services buildings" such as fire stations, police stations, and city halls. There is a "reluctance to plan ahead and spend the money for that 'ounce of prevention,'" Alquist declared.

## TURNING LESSONS INTO ACTION

Representing the Wilson Administration, **Traci Stevens** is the Deputy Secretary for Legislation in the State and Consumer Services Agency. Governor Wilson designated the Agency as the coordinator of the Administration's earthquake efforts. Stevens referred the legislators to her written testimony [see the yellow pages] which included a report on the status of the 26 specific recommendations from the Seismic Safety Commission that fall within the Committee's policy jurisdiction. She declared success for the three proposals which officials put in the "high priority" category because the Legislature enacted the necessary bills. The 10 proposals in the "moderate priority" category are mostly local land use changes. The Administration is looking at an overall seismic policy which involves coordinating with all of the affected state departments, as well as with the cities and counties. "By better communicating" we hope to be "more successful," Stevens declared.

To coordinate the Administration's efforts, the Agency hired former State Architect Harry Hallenbeck as its Director of Seismic Safety Implementation. Hallenbeck attended the Committee's hearing with Stevens but did not testify.

According to Stevens, the Administration's proudest seismic safety success in 1996 was the enactment of SB 1864 (Alquist, 1996) which appropriated \$2 million a year for five years to relocate the National Center for Earthquake Engineering Research from New York to California. After the National Science Foundation (NSF) originally decided to locate the Center in New York, the State of New York cut its financial support. California officials believe that with this new appropriation, NSF may move the Center from New York to California.

Another accomplishment was a \$200,000 grant from the Federal Emergency Management Agency (FEMA) to the California Building Standards Commission to revise the State Historical Building Code. Regarding the retrofit of state buildings to improve their ability to survive an earthquake, Stevens reported that the Governor's proposed 1997-98 State Budget will allocate the \$91 million remaining from the \$250 million in state bonds from Proposition 122, approved by the voters in 1990. There will be more reconstruction of bridges and highways, she added.

Noting the difference of opinion between Governor Wilson's Administration and the Legislature over who should pay for retrofitting toll bridges in the San Francisco Bay area, **Senator Sher**



asked Stevens what the Administration would propose in 1997. Stevens said that she did not have an answer but would find out.

**Chuck Real**, a Senior Geologist with the California Division of Mines and Geology in the State Department of Conservation, reported to the Committee on the status of the seismic hazard zone mapping program. The Division just released the first six preliminary maps for public review. After considering comments, the Division will issue the official maps for these areas on March 1, 1997. Ten more preliminary maps will be available in April 1997, with official maps ready in October 1997. The remainder of the maps will come out in 1998. Real provided legislators with sample copies of the preliminary maps and other background information [see the **yellow pages**].

"Bring it a little closer to home," **Senator Sher** urged. When will the Division release the seismic hazard zone maps that cover the South Bay? Real responded that with "no reality of funding," he could not estimate when the South Bay maps might be ready although "I wish I could." Sher followed by saying that he hoped it did not take another severe earthquake in the San José area to attract FEMA money to pay for the necessary maps. When Senator Sher asked how local officials will use the maps, Real conceded that there is no state mandate to use the new information and that their use "depends on voluntary local compliance." Local officials decide on any appropriate mitigation measures and that "varies from jurisdiction to jurisdiction."

Responding to a question from **Senator Watson** about the utility of retrofitting and site preparation, Real explained that compaction, de-watering, and containment work can improve a building's site and even modest investments can improve the building's survivability. Senator Watson then asked if Caltrans will use the Division's seismic hazard zone maps to set priorities for retrofitting freeways and bridges. Real responded that state agencies are supposed to use these maps for their own work. Senator Watson encouraged better cooperation among state officials.

Responding to another inquiry from **Senator Watson**, Real explained that state law does not require local officials to place an area "off-limits" to development because the property is in a seismic hazard zone. Unlike the Alquist-Priolo Act which prohibits buildings in rupture zones, local officials may impose mitigation requirements. Real and Watson then discussed the availability of the state's maps which the Division sends to each planning department. Senator Watson remained concerned that people may not really know the condition of the ground where their homes are.

## "SHAKEN AWAKE!"

San José City Councilmember **Charlotte Powers** is also the current President of the Association of Bay Area Governments (ABAG), the regional planning agency for the San Francisco Bay Area. Calling the results of ABAG's study *Shaken Awake!* "sobering," Powers introduced the legislators to **Jeanne B. Perkins**, the study's author and ABAG's Earthquake Programs Manager.

There are significant probabilities of damaging earthquakes in the Bay Area in the next 30 years, Perkins reported. Therefore, public officials need to prepare for the inevitable damage to housing. Perkins illustrated her comments with slides which are also available on ABAG's multi-media

compact disk and in written form [see the yellow pages]. Her testimony described the likely consequences of probable earthquakes. She praised the utility of retrofitting older buildings, claiming a "factor of ten" difference between damage to buildings with unbolted foundations and those bolted to their foundations. Perkins said that it was "incredulous" for the new state law setting up the California Earthquake Authority (CEA) to allow a discount of only 5% for bolting. It ought to be 90%, she said.

Also concerned about the CEA's rating system, **Senator Sher** recounted the debate over the CEA and why the first attempt failed to pass on the floor of the State Senate. After the legislative conference committee revised the risk ratings, the CEA bill passed. Sher commented that it would be "interesting and difficult" to pin down earthquake risks to precise areas.

**Senator Watson** expressed her continuing disappointment with local school officials who seek waivers from the Field Act, the state law that set earthquake building standards for older schools. Perkins concurred that schools need to be safe because the Red Cross and other organizations rely on schools surviving earthquakes so that emergency service groups can use them as shelters. Watson also observed that the government's policy on earthquake aid is reversed. People who don't retrofit get more aid than those who retrofit their buildings.

## "RESIDENTIAL EARTHQUAKE RECOVERY"

Also using slides to illustrate her comments, UC Berkeley Architecture Professor **Mary C. Comerio** described the findings of her new study Residential Earthquake Recovery [see the yellow pages].

After the Northridge Earthquake, the "ghost towns" were not uniformly distributed across the San Fernando Valley but clustered in specific areas that had unstable ground. With the recession causing a relatively high vacancy rate of 9.5%, tenants who were displaced from damaged apartments were able to find other undamaged places to rent. After the Northridge Earthquake, the Valley's rental vacancy rate fell to 2%. Because the Bay Area's rental vacancy rate is below 4%, the region's rental market could not absorb a similar loss of rental housing stock.

Of the 60,000 units that were severely damaged by the Northridge Earthquake, 90% were in multifamily buildings. Curiously, it was the owners of the larger, newer buildings who faced negative equity and negative cash-flows. The owners of smaller, older buildings did better because their buildings were fully rented and because they could invest personal savings into repairs. The "true cost" of the Northridge Earthquake was over \$40 billion, Comerio said, with about half the damage attributable to residential property. That ratio is typical of other major disasters, she noted.

"What did we learn?" Comerio asked. She answered her own question by reminding the legislators that the conventional wisdom says that structural damage drops as distance from the fault increases, but the data from the Northridge Earthquake show insurance claims for serious damage from up to 70 kilometers away. Another lesson is that "earthquakes are expensive," Comerio



stated. The costs are not just the obvious structural damage but economic damage as well, and the bad news is that this damage is expensive to fix.

Comerio and other researchers think that the CEA's rate structure is wrong but she is "not as outraged about the CEA as some of my colleagues." She readily agreed that it is appropriate to create an insurance pool to cover catastrophic damage. But some economists worry that the CEA will offer only a single type of insurance policy and yet there is a need for more insurance products. When **Senator Sher** asked Comerio if she thought that market forces would prevail, she responded by saying that insurance companies are not likely to aggressively market new products unless there is a climate for them. One way to stimulate that market climate is for the government to encourage research into earthquake damages. The state government holds the necessary data on insurance claims, building types, and soils, and the National Center for Earthquake Engineering Research could sponsor that research. It should be possible to estimate the seismic hazard risk for each individual building.

Nevertheless, Comerio noted, the state government will never be able to afford to pay for residential recovery. Government can respond to emergencies, but recovery is a private matter. Government sponsored mitigation measures will help with recovery. Comerio claimed that 25% of the houses in California would be safer today if Governor George Deukmejian had not vetoed the bill that would have required the installation of foundation anchor bolts when single-family homes sell. Comerio said that three lessons about mitigation emerged:

- Mitigation works.
- Housing markets do not reward owners who mitigate with higher sales prices or rents.
- Political reasons prevent the public sector from requiring appropriate mitigation.

Comerio concluded by pointing out that mitigation must "be in their pocketbook interest" before insurance companies and consumers respond. There must be creative thinking, such as allowing "Earthquake Savings Accounts" that would allow homeowners to set aside untaxed savings to be spent on recovery efforts after disasters.

## REACTION AND RESPONSE

Following the individual presentations, Senator Sher called on a three-member panel to offer their reactions and responses. The first panelist was **Michael Flores**, a Senior Planner with the City of San José. Flores told the legislators that "it's one thing to know where the hazards are, it's another thing to plan for them." For example, revising the safety elements in local general plans makes sense only when new information becomes available. If there is no new information, a state law that would require regular revisions every five years may not make sense. San José officials have linked the land use and safety elements in their general plan by using hillside designations and urban limit lines to keep new development out of seismically hazardous areas. San José has also linked the planning function to implementation programs by insisting that developers use mitigation measures for buildings in hazardous areas.

Speaking for the California Building Officials (CALBO) was **Andrew Adelman** who is also the Chief Building Official for the City of San José. Adelman gave the Committee copies of his articles on earthquakes and building codes [see the **yellow pages**]. Echoing Flores, Adelman explained that the City requires "special geologic hazard studies" in risky areas. San José adopted this local requirement because "we don't want to put people in harm's way." Because building officials must enforce these codes, they want "practical, clear, concise" building codes. Complexity adds to difficulty, making the codes hard to administer given the extreme variety and fast pace of building inspectors' workloads. For example, Adelman estimated that his inspectors would have completed 200 inspections just during the 2½ hours of the Committee's hearing.

Although he understands the Legislature's desire to add special rules for earthquakes, Adelman responded to a question from **Senator Sher** by suggesting that the 1997 Uniform Building Code would contain the necessary earthquake standards. He thanked the legislators for enacting AB 717 (Ducheny, 1995) which raised the professional standards of local building officials.

**Diane Colburn** represents the Personal Insurance Federation of California, a trade group whose members write about 40% of the homeowners and earthquake insurance in California. Because she expects to see legislation in 1997 to clean-up the CEA, she concentrated her remarks on how the insurance industry handles retrofitting and how the CEA approaches retrofitting. Responding to what Colburn called a "misconception" about the CEA law, she said that the statute requires the CEA to set a discount of at least 5% for retrofitting, although the specific amount is subject to the Proposition 103 rate-setting process.

Colburn explained that the CEA's rating plan uses three time periods to classify residential property: those built before 1960, those built between 1961 and 1978, and those built after 1978. When **Senator Sher** reminded her that those time periods do not fit with the damage that Professor Comerio found, Colburn explained that the dates track the major changes in the Uniform Building Code. Most insurers will not write a policy for a pre-1950 home unless the building has been retrofitted.

Colburn and Sher continued their discussion of insurance policies that would be more extensive than the CEA's basic policy. Although "wrap-around" policies will be available, they "will be pretty expensive," Colburn explained. Sher quipped that "the professor will be pleased to know that she'll be able to buy it but it'll cost her a lot of money." Sher added that "frankly, you're going to hear a lot more" about retrofitting, particularly if it "helps to keep the CEA solvent." When Colburn countered that mandating discounts can be complex with many factors to consider, Sher replied that "all my witnesses tell me that they can do it." Industry should keep an open mind about retrofitting and rates. The Legislature needs to look at this research and "take that message back to the companies."

### ADDITIONAL ADVICE

After the scheduled witnesses finished their presentations, Senator Sher invited people in the audience to offer additional advice. Two did.



**Dr. Frances Winslow** is the Director of Emergency Services for the City of San José and a former member of the California Seismic Safety Commission who was involved in the preparation of the Commission's report, Turning Loss to Gain. She encouraged the Committee to return to the issue of automatic shut-off valves for natural gas lines that serve mobilehome parks. San José has more mobilehomes than any other city and the fire danger after an earthquake is a significant threat. Further, Winslow urged the Committee to review the law that impedes the installation of available safety devices under mobilehomes. Attaching a mobilehome to the ground improves its survivability in an earthquake but may cause the ownership title to transfer to the landowner. She asked the Committee to find a way to encourage mobilehome owners to install safe foundations without having to convert their homes into real property.

Winslow urged the legislators to pay close attention to the Seismic Safety Commission's recommendations because they represent the best professional advice, unfiltered by political considerations. She also praised ABAG's Shaken Awake! study and encouraged the legislators to think about creative economic incentives to promote retrofiting. Banks, for example, will benefit from retrofiting if they can offer lower-interest loans to pay for the work. Mobilehome owners may not have the equity to finance their own private retrofit efforts, but insurance companies should discover their own economic self-interest in retrofit.

**Leo Ruth** is a retired civil engineer and architect who now lives in Watsonville. "Mitigation needs financial incentives," Ruth declared. He contended that the State Department of Finance killed SB 1490 (Rogers, 1996) which would have required more disclosure to clients [see the blue pages]. Financial institutions should "provide elucidation" to the Department to demonstrate the economic benefits of mitigation.

The proceedings completed, **Senator Sher** closed the Committee's hearing at 1:00 p.m.

After the hearing, the Committee received a letter from Inyo County Planning Director **Peter Chamberlin** [see the yellow pages]. Although keeping general plan elements "as current as possible" is desirable, legislation requiring counties to update their safety elements would be another state mandate and "the state should pay for it." The cost of state mandates is a particular burden for so-called "frontier counties" which are fundamentally different from Bay Area counties. Further, the proposal to amend the Map Act and require geologists to review proposed development projects for seismic hazards "could be very expensive to the subdivider."

The Committee also received written advice from **Dr. Robert J. Kuntz**, President of the California Engineering Foundation [see the yellow pages]. The Foundation advocates "performance based engineering design" that considers structures as operating systems not just containment vessels. Dr. Kuntz's materials review several bills, including SB 1490 (Rogers, 1996) which Governor Wilson vetoed. Kuntz argues for harnessing state tax policy to encourage earthquake hazard mitigation efforts. In addition to reviewing eight specific lessons learned from the Northridge Earthquake, Kuntz repeated his Foundation's commitment to the mission of public education on earthquake hazards.





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# **An Ounce of Prevention: Planning & Regulating for Seismic Hazards**

## **A Background Staff Paper for the Interim Hearing**

**Wednesday, October 16**

**San José City Hall, Room 106  
801 North First Street  
San José, California**



## **An Ounce of Prevention: Planning & Regulating For Seismic Hazards**

*The great majority of California's population --- rich and poor --- now lives within 20 miles of a major earthquake fault. ... California cannot afford a future in which there are no sources of funding to recover from a major urban earthquake. ... The state must take a stand for more intelligent use of federal funds, for smarter and smaller subsidies to private citizens for recovery, and for encouraging cost-saving mitigation.*

Professor Mary C. Comerio  
September 1996

This background paper prepares the members of the Senate Housing and Land Use Committee and other legislators for the hearing, "*An Ounce of Prevention: Planning & Regulating For Seismic Safety*," on Wednesday, October 16, 1996, at the San José City Hall.

An *interim hearing* is a special meeting that a legislative committee conducts during the California Legislature's fall interim recess. One of the central purposes of any legislative body is to study public policy issues before they become crises. Last fall, for example, the Committee held an interim hearing in Los Angeles on "Earthquake Safety & Building Codes." Since then, researchers have challenged policy makers to act on the problems associated with residential buildings made uninhabitable by the next, inevitable earthquake.

This year's hearing --- just a day before the seventh anniversary of the Loma Prieta Earthquake --- will prepare legislators to draft, author, and vote on bills that respond to two types of problems:

- The unfinished agenda of lessons learned from the Loma Prieta and Northridge earthquakes.
- Adjusting federal, state, and local programs to help residents find shelter after disasters.

This paper has four parts. The **first** part summarizes the existing state laws on planning for seismic hazards. The **second** part reviews recommendations of the Seismic Safety Commission's 1995 report, Turning Loss to Gain. The paper advises legislators about the steps that state and local officials have taken to turn these ideas into action. The **third** part reviews the key findings and recommendations of two provocative and challenging reports:

- Shaken Awake! (April 1996) by ABAG's Jeanne Perkins.
- Residential Earthquake Recovery (October 1996) by UC Berkeley's Mary Comerio.

The **fourth** and final part of this paper suggests policy questions that legislators may want to pose to the witnesses at the October 16 hearing.

## Planning For Seismic Hazards

In response to successive earthquakes, the Legislature enacted several statutes that require state and local officials to plan for seismic risks. Because they passed at different times and because they receive different amounts of political and budgetary support, these laws do not form a consistent, seamless system to protect Californians and their property from seismic hazards. Instead, they amount to a poorly coordinated collection of good ideas, partially implemented. They lack coordination and consistent application. *Planning for hazards is haphazard.* To demonstrate the variety of efforts, this section of the paper summarizes the key features of those laws.

*The Planning and Zoning Law* requires cities and counties to adopt general plans with seven elements: land use, circulation, housing, conservation, open space, noise, and safety. The Legislature mandated the safety element after the 1970 wildfires and the February 1971 San Fernando earthquake (SB 351, Alquist, 1971). Safety elements must address seismic hazards, floods, fires, and related land use issues (Government Code §65302 [g]).

State planning laws also require cities and counties to "prepare, periodically review, and revise, as necessary, the general plan" (Government Code §65103 [a]). Local planning officials must conduct annual reviews of the status of their general plans, and then report to their city councils or county supervisors (Government Code §65400 [b]). The Governor's Office of Planning and Research (OPR) must notify cities and counties if their plans have not been revised within eight years. If a local general plan is more than 10 years old, OPR must notify the Attorney General (Government Code §65040.5).

A 1988 staff report by the Division of Mines and Geology in the State Department of Conservation demonstrated that many cities and counties had not kept their safety elements up to date. The Division's staff surveyed local planning departments to see if they had revised their elements since 1984, "given the availability of new data in the last four years." Nearly 75% of county safety elements and 58% of city safety elements were adopted before 1984.

Because cities and counties were not using the state's latest information in their safety elements, the Legislature required local officials to consult with the Division of Mines and Geology and the Office of Emergency Services to obtain current information. At least 45 days before adopting or amending a safety element, local officials must submit copies of their drafts to the Division for comment. The Division may review the draft documents. If it does, the Division must report its findings within 30 days and local officials must "consider" the advice before adopting or amending their safety elements (AB 890, Cortese, 1989).

A 1996 OPR publication reported the results of an annual survey of local governments' general plan elements. For the four counties most affected by the 1989 Loma Prieta Earthquake, the results are startling: *55% of the safety elements in those counties have not revised since the earthquake.* Nearly a quarter of the elements date from the 1970s. The table on page 3 presents the information that local officials reported to OPR.



**STATUS OF SAFETY ELEMENTS**  
**ALAMEDA, SAN FRANCISCO, SAN MATEO, & SANTA CLARA COUNTIES**

<u>Name of Community</u>	<u>Last Revised</u>	<u>Name of Community</u>	<u>Last Revised</u>
<u>County of Alameda</u>	1982	<u>County of Santa Clara</u>	1994
Alameda	1991	Campbell	1975
Albany	1992	Cupertino	1993
Berkeley	1977	Gilroy	1983
Dublin	1992	Los Altos	1987
Emeryville	1993	Los Altos Hills	1973
Fremont	1991	Los Gatos	1991
Hayward	1977	Milpitas	1994
Livermore	1976	Monte Sereno	1982
Newark	1992	Morgan Hill	1977
Oakland	1974	Mountain View	1992
Piedmont	1995	Palo Alto	1981
Pleasanton	1986	San José	1994
San Leandro	1989	Santa Clara	1992
Union City	1986	Saratoga	1987
		Sunnyvale	1986
<u>County of San Mateo</u>	1986	<u>San Francisco</u>	1974
Atherton	1990		
Belmont	1982		
Brisbane	1994		
Burlingame	1975		
Colma	1993		
Daly City	1994		
East Palo Alto	1986		
Foster City	1993		
Half Moon Bay	1991		
Hillsborough	1994		
Menlo Park	1976		
Millbrae	1974		
Pacifica	1983		
Portola Valley	1982		
Redwood City	1990		
San Bruno	1984		
San Carlos	1992		
San Mateo	1990		
South San Francisco	1976		
Woodside	1988		

**SUMMARY**

Last revised in the 1970s:	12	(23%)
Last revised in the 1980s:	17	(32%)
Last revised in the 1990s:	<u>24</u>	(45%)
	53 communities	

In 1996, the Seismic Safety Commission sponsored **SB 1874 (Alquist)** which would have implemented several of the recommendations from the Commission's report, Turning Loss to Gain. The Senate Housing and Land Use Committee passed SB 1874 but the bill died in the Senate Appropriations Committee. SB 1874 was not the first attempt to require the Division of Mines and Geology to review local safety elements. AB 1150 (Cortese, 1987) passed the Senate Local Government Committee but failed in the Senate Appropriations Committee. Had it succeeded, Senator Alquist's bill would have:

- Required cities and counties to review their safety elements every five years and, if needed, revise the elements to incorporate new information.
- Required the Division of Mines and Geology to review draft safety elements to determine if they incorporate the seismic hazards identified under the Seismic Hazards Mapping Act.
- Added the location of hazardous material to the required contents of safety elements.

Except for the housing element, state law does not require local officials to revise their general plans on a regular schedule. Cities and counties must revise their housing elements every five years, following a statutory staggered schedule. Although SB 1874 would have required local officials to review and revise their safety elements every five years, it did not set specific deadlines. Because the plans' elements must be internally consistent, cities and counties probably would have revised their safety elements when they revise their housing elements.

By requiring cities and counties to revise their safety elements regularly, SB 1874 would have created a new state mandate. Experience suggests that the mandate may not cost much. Cities and counties haven't filed any reimbursement claims for the 1989 mandate that required cities and counties to send their draft safety elements to Sacramento for review. Further, local planners can use the maps provided by state officials.

Also prompted by the 1971 San Fernando Earthquake, the 1972 *Alquist-Priolo Earthquake Fault Zoning Act* requires the State Geologist to identify earthquake fault zones for the potentially and recently active traces of four major faults (Public Resources Code §2621, et seq.). The earthquake fault zones are usually a quarter-mile wide. After review, the State Geologist sends these maps to cities and counties for local officials to use when making planning and development decisions (Public Resources Code §2622). City councils and county boards of supervisors may amend their general plans to include the Alquist-Priolo maps. They must require geologic reports on development projects proposed within earthquake fault zones (Public Resources Code §2623). Sellers must disclose the existence of an earthquake fault zone to prospective buyers (Public Resources Code §2621.9).

A 1990 evaluation of the Alquist-Priolo Act, commissioned by the Department of Conservation, found that "overall, the ... program has been effective and has served its purpose well." By January 1994, the State Geologist's earthquake fault zone maps covered 36 counties and 94 cities.



Because the maps cover the San Andreas, Calaveras, and Hayward faults, many of these communities are in the South Bay.

After the October 1989 Loma Prieta earthquake, the Legislature passed the *Seismic Hazards Mapping Act* (AB 3897, W. Brown, 1990; Public Resources Code §2690, et seq.). The State Geologist must compile maps of earthquake fault zones, landslide hazards, dam inundations, and the effects of tsunami and seiche. After public review, the State Geologist sends the official maps to state officials, cities, and counties (Public Resources Code §2696). Cities and counties must "take into account" this information when preparing their safety elements (Public Resources Code §2699). Before they can approve development in a seismic hazard zone, local officials must require a geotechnical report (Public Resources Code §2697). Sellers must disclose the existence of a seismic hazard zone to prospective buyers (Public Resources Code §2694).

On October 8, the Division of Mines and Geology announced the release of its seismic hazard maps for areas affected by the January 1994 Northridge Earthquake. That first set of maps also covers San Francisco, hit by the October 1989 Loma Prieta Earthquake. Because the State Geologist has concentrated his mapping efforts on Southern California communities, there are no seismic hazard maps that cover communities in the South Bay.

## "Turning Loss to Gain"

Shortly after the January 1994 Northridge Earthquake, Governor Pete Wilson directed the Seismic Safety Commission to coordinate a study of the disaster's policy implications, with particular attention to seismic structural safety and land use planning. The Commission's resulting report, Turning Loss to Gain, contained 168 recommendations, 26 of which fall within the jurisdiction of the Senate Housing and Land Use Committee.

The recommendations from Turning Loss to Gain appear in *italics*. Following each recommendation is a brief report on what, if anything, has happened to implement that proposal. Where a bill addressed the Commission's recommendations, it appears in **boldface type**.

### Local Planning and Development.

1. *Legislation be enacted to require that, by the year 2000, local general plan safety elements contain a generalized description of all typical building types and vintages in the community's neighborhoods, with a special emphasis on those vulnerable to collapse from seismic hazards, and a plan to mitigate the risk from these structures. Status: Although the Seismic Safety Commission sponsored SB 1874 (Alquist, 1996) to revise the contents of local safety elements, this recommendation was not part of the bill which died in the Senate Appropriations Committee.*
  
2. *Legislation be enacted requiring review of the safety element of general plans every five years to incorporate new information; the information in maps prepared under the Seismic Hazards Mapping Act (SHMA) should be incorporated within one year of the date final maps are provided to local jurisdictions. Status: The Seismic Safety Commission sponsored SB 1874 (Alquist, 1996) which died in the Senate Appropriations Committee.*
  
3. *Legislation be enacted to make the existing optional California Division of Mines and Geology (CDMG) review of safety elements mandatory for CDMG. Status: The Seismic Safety Commission sponsored SB 1874 (Alquist, 1996) which died in the Senate Appropriations Committee.*
  
4. *Legislation be enacted to require that the safety elements of general plans address seismic vulnerability of existing building stock, or inventory, and contain risk-mitigation strategies. Description of the building stock should be included in enough detail to support the risk-mitigation strategy. Status: Although the Seismic Safety Commission sponsored SB 1874 (Alquist, 1996) to revise the contents of local safety elements, this recommendation was not part of the bill which died in the Senate Appropriations Committee.*
  
5. *Legislation be enacted to require local general plans and emergency plans to address post-earthquake recovery and planning. Status: Although the Seismic Safety Commission sponsored SB 1874 (Alquist, 1996) to revise the contents of local safety elements, this recommendation was not part of the bill which died in the Senate Appropriations Committee.*

6. *Legislation be enacted to amend the Subdivision Map Act to require that geologic and geotechnical reports addressing seismic hazards be required for all major (five lots or more) subdivisions unless information is already available or until superseded by Seismic Hazards Mapping Act (SHMA) maps and that reports be reviewed by local government staffs or consultants with appropriate credentials. Status: No legislator has introduced a bill.*
7. *Legislation be enacted to amend land use laws to require state and local agencies to make specific findings regarding the acceptability of inundation hazards before approving development of critical facilities (for example, hospitals, schools, emergency response facilities, hazardous material storage, and sewer treatment plants) within potential inundation areas. Status: No legislator has introduced a bill.*
8. *Legislation be enacted to add to the definition of "blight," when designating a redevelopment project area, those structures deemed by the local jurisdiction to pose an unacceptable risk of collapse in earthquakes. Status: Assemblyman Hauser authored AB 189 (1995) which Governor Wilson signed into law as Chapter 186, Statutes of 1995.*

#### **Building Code Preparation and Enforcement.**

9. *Legislation be enacted to make structural plan checking of engineered buildings an act requiring professional licensing. Status: The Seismic Safety Commission sponsored SB 914 (Alquist, 1995). A February 1995 opinion by the Attorney General, acting on behalf of the Department of Consumer Affairs, concluded that licensed engineers and architects must conduct plan checks. Because the legal opinion made the bill moot, Senator Alquist dropped SB 914.*
10. *Legislation be enacted to require building inspectors and public and private plan checkers to be trained and certified by nationally recognized organizations and subject to continuing education requirements by recognized organizations in their area of competence. Inspectors and plan checkers should be restricted from inspecting and checking plans beyond their areas of certification and competency. Status: The Seismic Safety Commission, the California Building Officials, and the California Building Industry Association co-sponsored AB 717 (Ducheny, 1995) which Governor Wilson signed into law as Chapter 623, Statutes of 1995.*
11. *Legislation be enacted to designate California Building Standards Commission (CBSC) as the entity responsible for the adequacy of the seismic safety codes and standards for all buildings in California. CBSC should ensure that building codes and their administration meet the state's acceptable levels of seismic risk through various actions, including but not limited to:*

*Ensuring the adequacy of existing and future seismic safety requirements in the model codes and state amendments.*

*Developing and adopting new seismic safety requirements for amendments to the building code for statewide applications.*



Status: No legislator has introduced a bill to assign this authority to the CBSC. Prompted by the failure of "steel moment welds" in buildings during the Northridge Earthquake, the California Building Officials sponsored and the Governor signed AB 3772 (Ducheny, 1996). The bill permits the CBSC to adopt emergency regulations outside of the regular cycle for adopting building codes. The proposed adoption of a nationwide building code in 1999 forces California officials to consider whether a state agency should ensure that the new national standards account for California's special earthquake needs.

12. *Legislation be enacted to authorize CBSC to establish a task force including other affected and interested agencies and organizations to develop plans to fulfill this responsibility within one year of the above legislation.* Status: No legislator has introduced a bill. The CBSC has a Seismic Safety Committee which has applied to the Federal Emergency Management Agency (FEMA) for a federal grant to create a task force to write and implement a performance based code. The Commission expects an answer from FEMA later this fall.

### Existing Buildings.

13. *Legislation be enacted to require state and local building code enforcement agencies to identify potentially hazardous buildings and to adopt mandatory mitigation programs by the year 2000 that will significantly reduce unacceptable hazards in buildings by the target year of 2020.* Status: No legislator has introduced a bill. However, SB 597 (Alquist, 1992) appropriated \$320,000 to the State Architect to prepare seismic retrofit guidelines and standards by January 1, 1996. SB 597 also required the California Building Standards Commission to adopt these standards by July 1, 1997.

14. *The Legislature [should] revisit the state's 1986 Unreinforced Masonry (URM) Law and consider appropriate actions to address the inequities and the public's continuing exposure to risk that have resulted from the failure of a significant number of local governments to comply with the intent of the law so that approximately half of the state's URM buildings remain un-strengthened.* Status: No legislative committee has held the oversight hearing. The Seismic Safety Commission's staff believes that about 90% of the affected cities have identified URM buildings but only about 30% of those buildings have been reinforced.

15. *Legislation be enacted to require owners of potentially hazardous buildings to disclose seismic risk to potential buyers at the time of sale, to lenders, and to tenants on entering into or renewing leases, or when they relocate within a building.* Status: Although sellers give buyers copies of the "Homeowner's Guide to Earthquake Safety" and the "Commercial Property Owner's Guide to Earthquake Safety," there is no similar law requiring notice to lenders or lessees. Governor Wilson vetoed SB 1490 (Rogers, 1996) which would have required design professionals to explain the seismic standards of the California Building Standards Code to their clients. Although he called additional disclosure "a laudable goal," the Governor concluded that "it simply makes no sense to impose this requirement on every ... project."

16. *Legislation be enacted to allow the warning placards required by existing law to be removed from potentially hazardous buildings that have been retrofitted in substantial compliance with the Uniform Code for Building Conservation, Chapter 1, provided that the disclosures in the preceding recommendation take place.* Status: No legislator has introduced a bill.

17. *Legislation be enacted to require owners and business operators to include warning placards at the entrances to hazardous buildings of all types, as well as seismic risk management and response plans as part of their overall emergency plans for safety in the workplace.* Status: No legislator has introduced a bill.

18. *Legislation be enacted to require the installation of Housing and Community Development (HCD)-approved Earthquake Resistant Bracing (ERB ) systems or other systems allowed by SB 750 (Roberti [1994]) on existing mobile homes when ownerships are changed or when homes are relocated.* Status: No legislator has introduced a bill. However, this issue may appear when the State Department of Housing and Community Development convenes a task force under SB 1704 (Craven, 1996) to draft a "transfer disclosure statement" for mobilehomes.

#### Essential Services Buildings and Utilities.

19. *Legislation be enacted to apply the Alquist-Priolo Act to publicly owned facilities, critical facilities, and lifelines, including public utility pipelines and facilities in which hazardous materials are used or stored, and to provide for alternative mitigation measures appropriate to lifelines.* Status: The Seismic Safety Commission sponsored SB 1720 (Alquist) which died in the Senate Toxics and Public Safety Management Committee.

20. *Legislation be enacted to require state and local agencies to review all pre-1986 essential services facilities for their ability to function after earthquakes and that those found deficient be retrofitted.* Status: The Seismic Safety Commission sponsored and the Governor signed SB 1953 (Alquist, 1994) which Governor Wilson signed into law as Chapter 740, Statutes of 1994. The bill required the Office of Statewide Health Planning and Development to adopt regulations for pre-1973 hospitals and then conduct compliance inspections. In 1996, the Seismic Safety Commission sponsored AB 3184 (Cortese, 1996) which would have required hospitals and other essential services buildings to have reliable emergency power and water sources. The Cortese bill died in the Assembly Health Committee.

21. *A general obligation bond measure be placed on the 1996 ballot to fund a state and local matching grant program or other funding mechanisms to carry out the recommendations in this section.* Status: No legislator has introduced another earthquake safety bond bill; no 1996 ballot measure. Money still remains from the earlier bond issue, Proposition 122.

22. *The Essential Services Act (ESA) be amended to require buildings designed as community shelters and those buildings that serve as the place of business for local governments, such as city halls, be placed within the definition of "essential services buildings."* Status: No legislator has introduced a bill.



23. *Automatic gas shut-off valves be mandatory at the service entry point at all mobile home parks in California.* Status: The Seismic Safety Commission sponsored **SB 577 (Rosenthal, 1995)** which would have implemented this recommendation. Assembly amendments deleted that requirement and instead expanded the type of gas shut-off devices subject to the State Architect's standards. Governor Wilson signed the amended bill as Chapter 152, Statutes of 1996.

#### State Agency Actions.

24. *Legislation be enacted to require CDMG to convene a high-level independent review board for the preparation and review of guidelines and maps under the SHMA.* Status: No legislator has introduced a bill.

25. *Legislation be enacted to allow designation of active fault zones based on all viable geologic, geodetic, and tectonic evidence and provide for alternative mitigation measures to be defined by the Mining and Geology Board as appropriate to complex areas where the location of potential fault ruptures is uncertain.* Status: The Seismic Safety Commission sponsored **SB 1720 (Alquist, 1996)** which died in the Senate Toxics and Public Safety Management Committee.

26. *Legislation be enacted to amend the Alquist-Priolo Act and the Seismic Hazards Mapping Act (SHMA) so they apply to all facilities that produce or store reportable quantities of acutely hazardous materials.* Status: The Seismic Safety Commission sponsored **SB 1720 (Alquist, 1996)** which died in the Senate Toxics and Public Safety Management Committee.



## "Shaken Awake!"

The 1989 Loma Prieta Earthquake left 13,000 housing units uninhabitable in the Bay Area, forcing 3,265 people to seek publicly provided shelter. The Northridge Earthquake resulted in 48,000 uninhabitable units, leaving the haunting images of "ghost towns" in the San Fernando Valley. In its April 1996 report, Shaken Awake!, the Association of Bay Area Governments (ABAG) projected the effects of plausible, future earthquakes on the San Francisco Bay Area. For South Bay communities, ABAG's numbers are cause for concern.

Using computer models of earthquake shaking, information about housing conditions, and actual data from the Loma Prieta and Northridge disasters, ABAG estimated the number of housing units that would be unsafe after 11 possible earthquakes in the Bay Area. Six of those scenarios substantially affect communities in San Mateo, Santa Clara, and Alameda counties, as the following table reports:

### Earthquakes' Estimated Effects on Housing and People

<u>EVENT</u>	<u>UNINHABITABLE HOUSING UNITS</u>	<u>PEOPLE DISPLACED</u>	<u>PEAK SHELTER POPULATION</u>
Peninsula San Andreas	45,735	108,908	28,984
San Gregorio Fault	16,119	37,843	10,671
Northern Hayward	87,831	211,145	63,496
Southern Hayward	76,309	195,232	54,686
Hayward Entire Length	150,087	370,640	106,212
Northern Calaveras	15,428	39,749	9,951

The ABAG report properly notes that "uninhabitable" dwellings are not necessarily destroyed, and most can be repaired. But until repairs are complete, single-family homes may be "red tagged," and building inspectors will prohibit entry. For apartments and other multi-family dwellings, the buildings may be red tagged or "yellow tagged" where building inspectors must restrict entry.

Earthquakes on the Hayward Fault will result in the biggest number of uninhabited dwellings. In addition to the housing units destroyed by earthquakes reported on the previous page, even more housing will be lost to fires, liquefaction, and landslides. The ABAG report did not estimate those additional losses.

ABAG suggests that local officials can use these estimates to:

- Alert building departments to the need for inspectors after earthquakes.
- Estimate the demand for emergency shelters immediately after earthquakes.
- Estimate the demand for long-term housing assistance, certainly for low-income families.
- Demonstrate the need to retrofit and strengthen pre-1940 wood frame dwellings.

Because ABAG's computer models use detailed census data, its report estimated the amount of uninhabitable housing by type of construction and by community. For example, ABAG estimates that a magnitude 7.1 earthquake along the Peninsula segment of the San Andreas fault will make 45,735 housing units uninhabitable. The model projects that 13,166 of these uninhabitable dwellings will be in communities in San Mateo County with 2,624 of those units in Redwood City. How will Redwood City officials find enough building inspectors to red-tag and yellow-tag these buildings? How will Redwood City officials cope with the 1,705 residents who will need public shelter? How will Redwood City officials help low-income residents find affordable housing in a (literally) shattered housing market? How will businesses, industries, and public agencies that rely on low and moderate-income workers recover if their employees lack adequate housing?

In another illustration of the housing problems that can result in the South Bay, ABAG estimates that a 7.3 magnitude earthquake along the entire length of the Hayward Fault will make over 150,000 housing units uninhabitable throughout the Bay Area. ABAG's model projects that 13,443 of these uninhabitable units will be in the communities of Santa Clara County. Sunnyvale officials will have to cope with 2,592 uninhabitable housing units, and a public shelter population of 1,528. Even in a community relatively unaffected by this earthquake, the demand for housing will spill over from adjacent communities. The City of Campbell will lose only 23 units and just 13 people will need public shelter, but the demand for housing will push up prices as people move in from other, more damaged communities like Mountain View, Santa Clara, and Sunnyvale.

California residents, industries, and their governments are among the best-prepared in the world to respond to earthquake damage in the immediate period of emergency response and rescue. But the ABAG report reminds Californians --- especially state legislators and local officials --- that neither the private market nor the public sector is prepared to cope with the massive housing problems that appear inevitable after a major Bay Area earthquake.

## "Residential Earthquake Recovery"

The problem of rebuilding a region's housing stock after an earthquake is massive. According to a just released study, the actual cost of residential rebuilding from the Northridge Earthquake is not the more commonly quoted \$1.5 billion estimate but *\$12-\$13 billion*.

Prepared by Architecture Professor Mary Comerio and her colleagues at UC Berkeley, and published by the California Policy Seminar, the Residential Earthquake Recovery report reaches conclusions that should shake policy-makers' confidence. Comerio found two fundamental lessons from looking at the Northridge and Loma Prieta Earthquakes:

- While public officials have improved their ability to deliver emergency relief after large urban disasters, *no equivalent level of preparation has gone into the much bigger task of coordinating and paying for post-disaster rebuilding.*
- Although damaging earthquakes will occur in the future, *we cannot expect that private insurers or federal agencies will be willing or able to compensate victims with a comparable level of rebuilding assistance* as provided after the Northridge Earthquake.

Comerio's study traces the lessons that local, state, and federal disaster officials learned in the 1980s and 1990s. Emergency services improved, as did public agencies' preparations to respond to residents' immediate housing needs. But neither the private sector nor public agencies understood the extent of damage to housing. After the Northridge Earthquake, building inspectors estimate that the total value of the damage to houses in Los Angeles County was about \$1.5 billion. She called the building inspectors' work careful and diligent under difficult conditions but noted near impossibility of obtaining quick and reliable dollar estimates of residential damage. Policy makers and program administrators should avoid making quick judgments based on these immediate estimates. By researching 160,000 insurance claims, and then adding federal loans and grants, Comerio estimates that the actual cost of residential rebuilding was \$12-\$13 billion. Between 2/3 and 3/4 of the cost has come from private insurance payouts: \$8-\$10 billion.

From this research, Comerio and her colleagues reached four significant findings:

- *There have been real improvements in the ways federal and state agencies respond to major disasters.*
- *As evidenced in several recent large-scale natural disasters, repairs to private homes typically constitute at least 50% of the cost of the recovery.*
- *The major source of funding for post-disaster rebuilding has been and continues to be private insurance payouts.*
- *Although well intended, the current disaster recovery assistance programs administered by FEMA, and particularly by SBA and HUD, are operated in a largely ad hoc and uncoordinated fashion.*



These findings led the researchers to make four recommendations to policy-makers:

1. That the post-disaster period be seen as consisting of two distinct phases: (a) response and relief; and, (b) recovery and rebuilding. After caring for the victims' immediate needs, the recovery phase should focus on property damage. Where disasters can be planned for, the priority for public funding should go to buildings whose owners have undertaken hazard mitigation.
2. The primary financial responsibility for funding private post-disaster reconstruction should rest with private insurers. Only the private insurance industry has access to the volume of capital required to finance post-disaster reconstruction. But better underwriting is needed, along with other changes in insurance practices.
3. Increasing the responsibility and capacity of private insurers will mean decreasing the scope of publicly funded rebuilding programs. Government's *first* role is to fund the reconstruction of public infrastructure. The *second* role is to provide reconstruction funding to victims who can't afford private insurance, particularly low-income renters and the owners of multifamily housing. The *third* role is promoting applied research on disaster risk-underwriting. It is possible to develop models that will predict damage with reasonable accuracy, down to the individual house.
4. The best way to reduce the cost of post-disaster rebuilding, particularly post-earthquake rebuilding, is through mitigation. Three lessons emerged in the seven years since the Loma Prieta Earthquake:
  - Mitigation works.
  - Housing markets do not reward owners who mitigate with higher sales prices or rents.
  - Political reasons prevent the public sector from requiring appropriate mitigation.

From these lessons flow incentives and requirements that state officials and private insurers could undertake to promote cost-effective mitigation: tax credits, discounts, and inspections.

Professor Comerio and her colleagues John Landis, Catherine Firpo, and Juan Pablo Monzon conclude with this observation:

*California cannot afford a future in which there are no sources of funding to recover from a major urban earthquake. ... The state must take a stand for more intelligent use of federal funds, for smarter and smaller subsidies to private citizens for recovery, and for encouraging cost-saving mitigation.*



## Policy Questions

To prepare for the October 16 hearing in San José, the Committee members, other legislators, scheduled witnesses, and other interested persons may wish to consider the following issues.

**Local Planning and Development.** The Planning and Zoning Law that requires local officials to adopt safety elements in their general plans is not fully coordinated with either the 1972 Alquist-Priolo Act or the 1990 Seismic Hazards Mapping Act. Because the state program to identify seismic hazards requires careful work, maps for the South Bay communities affected by the Loma Prieta Earthquake may be years away.

- SHOULD THE LEGISLATURE REQUIRE LOCAL OFFICIALS TO REGULARLY REVIEW THE ADEQUACY OF THEIR GENERAL PLANS' SAFETY ELEMENTS?
- SHOULD THE LEGISLATURE EXPAND THE CONTENTS OF LOCAL SAFETY ELEMENTS, TO INCLUDE BUILDING TYPES AND RECOVERY EFFORTS?
- SHOULD THE LEGISLATURE REQUIRE THE DIVISION OF MINES AND GEOLOGY TO REVIEW ALL DRAFT SAFETY ELEMENTS AND DRAFT AMENDMENTS?
- SHOULD THE LEGISLATURE INCREASE THE FUNDING FOR THE SEISMIC HAZARDS MAPPING PROGRAM, TO ACCELERATE THE PRODUCTION OF MAPS FOR THE SAN FRANCISCO BAY AREA?

**Building Code Preparation and Enforcement.** Better designed and better constructed buildings can protect lives and property during major earthquakes. California has been a leader in including seismic safety concerns in its building codes. The development of a national building code is expected by 1999.

- DOES THE CALIFORNIA BUILDING STANDARDS COMMISSION HAVE SUFFICIENT AUTHORITY TO ENSURE THAT SEISMIC SAFETY REMAINS A CRUCIAL CONCERN IN FUTURE BUILDING CODES?
- DOES THE CALIFORNIA BUILDING STANDARDS COMMISSION HAVE SUFFICIENT ACCESS TO EXPERT, PROFESSIONAL ADVICE TO HELP IT REACH DECISIONS AFFECTING SEISMIC SAFETY?
- HOW CAN THE LEGISLATURE HELP THE CALIFORNIA BUILDING STANDARDS COMMISSION WITH ITS PENDING APPLICATION FOR A "FEMA" GRANT TO PAY FOR WRITING A PERFORMANCE BASED CODE? IS STATE FUNDING NEEDED?

**Existing Buildings.** Although higher standards improve the safety of new buildings, thousands of older buildings remain potential hazards. Some communities have been vigorous in encouraging the retrofit of older structures, others less enthusiastic.

- WILL THE STATE ARCHITECT AND THE CALIFORNIA BUILDING STANDARDS COMMISSION MEET THE 1997 DEADLINE FOR ADOPTING SEISMIC RETROFIT GUIDELINES?
- HOW FAR SHOULD THE LEGISLATURE GO IN FORCING LOCAL OFFICIALS TO IMPROVE THE SAFETY OF UNREINFORCED MASONRY BUILDINGS?
- WHAT OBLIGATION DO ENGINEERS AND ARCHITECTS HAVE TO EXPLAIN THE DIFFERENT LEVELS OF SEISMIC SAFETY TO THEIR CLIENTS? SHOULD THE LEGISLATURE PUT THIS OBLIGATION IN STATUTE?
- IS THERE EVIDENCE THAT WARNING PLACARDS ON POTENTIALLY HAZARDOUS BUILDINGS MAKE A DIFFERENCE TO BUILDING OWNERS, TENANTS, OR LENDERS? SHOULD THE LEGISLATURE EXPAND THE USE OF WARNING PLACARDS, OR DROP THE CURRENT PROGRAM?
- SHOULD THE LEGISLATURE REQUIRE THE INSTALLATION OF BRACING SYSTEMS WHEN OLDER MOBILEHOMES ARE SOLD OR MOVED?

**Essential Services Buildings and Utilities.** The survivability of key public buildings and utility services determines how fast a region's economy recovers from a major disaster. State programs recognize the importance of essential services buildings and state bond money is available to improve them.

- SHOULD THE LEGISLATURE BAN THE SITING OF CRITICAL SERVICES IN KNOWN EARTHQUAKE FAULT ZONES?
- SHOULD THE LEGISLATURE PROPOSE ANOTHER STATE BOND TO HELP PAY FOR PROTECTING ESSENTIAL SERVICES BUILDINGS? HOW MUCH? WHEN?
- SHOULD THE LEGISLATURE TRY AGAIN TO REQUIRE AUTOMATIC GAS SHUT-OFF VALVES AT MOBILEHOME PARKS?

**State Agency Actions.** The Legislature and successive governors have supported state agencies' involvement in gathering and distributing reliable geologic information to promote seismic planning and mitigation programs. But the legislators most experienced with seismic safety issues --- Senator Alquist, Assemblyman Cortese, and Senator Rogers --- are leaving the Legislature.

- WHERE WILL THE SEISMIC SAFETY COMMUNITY LOOK FOR LEGISLATIVE LEADERSHIP? WHICH LEGISLATORS ARE LIKELY TO AUTHOR BILLS, MONITOR PROGRAMS, AND SUPPORT NECESSARY FUNDING?
- IS THE ORGANIZATION OF THE EXECUTIVE BRANCH ADEQUATE TO SUSTAIN A HIGH LEVEL OF COMMITMENT TO SEISMIC SAFETY PROGRAMS? CAN STATE OFFICIALS COORDINATE PROGRAMS LOCATED IN VARIOUS DEPARTMENTS?
- DOES THE DIVISION OF MINES AND GEOLOGY NEED AN INDEPENDENT REVIEW BOARD TO HELP IT REVIEW SEISMIC HAZARD MAPS?
- SHOULD THE LEGISLATURE EXTEND THE ALQUIST-PRIOLO ACT AND THE SEISMIC HAZARDS MAPPING ACT TO HAZARDOUS WASTE MATERIAL FACILITIES?

**"Shaken Awake!"** ABAG's April 1996 report describes the potential for "ghost towns" in the South Bay when plausible, future earthquakes hit. Thousands of housing units will be uninhabitable and thousands of people will be displaced. The more affluent households will compete for what remains of the region's housing stock. Moderate and low-income families may require publicly provided shelter for months. Besides the social pressures caused by so many homeless families, private employers and public agencies may lose their workforces. The private economy will be slow to recover.

- WHAT CAN THE LEGISLATURE DO TO ENCOURAGE LOCAL BUILDING DEPARTMENTS TO PREPARE FOR EMERGENCY INSPECTIONS AFTER EARTHQUAKES?
- WHAT CAN THE LEGISLATURE DO TO IMPROVE THE AVAILABILITY OF EMERGENCY HOUSING IMMEDIATELY AFTER EARTHQUAKES?
- WHAT CAN THE LEGISLATURE DO TO PROMOTE LOCAL AND PRIVATE PROGRAMS TO RETROFIT THE HOUSES MOST AT RISK?
- HOW CAN THE LEGISLATURE HELP ABAG OBTAIN A "FEMA" GRANT TO DESIGN AND IMPLEMENT A PRIVATELY-FINANCED RETROFIT PROGRAM IN THE BAY AREA? IS STATE MONEY NEEDED?

**"Residential Earthquake Recovery."** The September 1996 study by UC Berkeley Architecture Professor Mary Comerio and her colleagues documents that the cost of residential reconstruction is much higher than officials originally estimated. Comerio's study argues that the state government should not pretend to fund residential rebuilding efforts. Instead, the study recommends relying on private insurers and redirecting state efforts to incentives and requirements that promote retrofitting residential housing, particularly multi-family buildings.



- WHAT COMBINATION OF PUBLIC INCENTIVES AND REQUIREMENTS WILL ENCOURAGE PRIVATE MARKET FORCES TO REWARD RETROFIT INVESTMENTS?
- SHOULD THE LEGISLATURE PROVIDE INCOME TAX CREDITS AND DEDUCTIONS FOR EARTHQUAKE MITIGATION INVESTMENTS?
- SHOULD THE LEGISLATURE REQUIRE INSURERS TO OFFER DISCOUNTS TO THOSE WHO MITIGATE AGAINST EARTHQUAKE DAMAGE?
- WHAT INCENTIVES CAN THE LEGISLATURE OFFER INSURERS TO CONDUCT EARTHQUAKE HAZARD AND MITIGATION INSPECTIONS?

## Sources & Credits

*This background paper was prepared by Peter Detwiler, Committee consultant, with the help of:*

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 Traci Stevens, Deputy Secretary for Legislation, State and Consumer Services Agency  
 Howard Yee, Senate Housing and Land Use Committee

*These printed sources were useful in the preparation of this paper:*

Maria Alexander, "A Status Report of City and County Safety Elements," Sacramento: Department of Conservation, Division of Mines and Geology, December 1988.

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**AN OUNCE OF PREVENTION:  
Planning & Regulating for Seismic Hazards**

**WRITTEN MATERIALS  
SUBMITTED TO THE COMMITTEE**



An Ounce of Prevention: Planning and Regulating for Seismic Safety

The Loma Prieta Earthquake: After Seven Years

Testimony Delivered to the Senate Committee on Housing and Land Use  
Byron D. Sher, Chairman

Dr. Richard Andrews, Director  
Governor's Office of Emergency Services

Thank you Senator Sher and Members of the Committee for inviting us to participate in today's hearing.

The Mission of OES

The mission of the Governor's Office of Emergency Services is multifaceted. We have responsibilities in areas that range from educating the public about preparing for earthquakes, assisting local governments to prepare, coordinating state and federal support to local government response, and finally to managing relief and recovery efforts.

Our Earthquake Preparedness Program produces and disseminates information for the general public and private sector on how to prepare for earthquakes and reduce damage. Training workshops provide schools, hospitals and small businesses with information critical to their continued operation after earthquakes. The OES Emergency Management Regions support local government preparedness, manage the state's mutual aid system and provide state and federal resources to assist local governments in their response. OES' California Specialized Training Institute (CSTI) provides training in emergency management to local governments. And, the OES Disaster Assistance Division manages federal and state disaster relief and recovery assistance. Our involvement with the Loma Prieta earthquake began years before it occurred with our preparedness efforts and will continue until reconstruction is complete.



## The Loma Prieta Earthquake

At 5:04 of October 17, 1989 we were once again jarred into the realization of our vulnerability to earthquakes in California. It had been more than 80 years since the last large quake struck the state. It was the first quake in eight decades to test the resilience of our communities, our communication and transportation systems, our ability to manage response, and our ability to recover. It was also the first earthquake disaster to test the effectiveness of California's intensified community preparedness and education efforts.

In retrospect, we can say with some pride that California's investments in preparedness and hazard mitigation had paid off. This is not to suggest that there were no problems, or that mitigation efforts had removed all hazards from our environment. Tens of thousands of older unreinforced masonry and non-ductile concrete buildings continue to pose a threat to public safety. Water, power and transportation systems remain vulnerable to disruption. Older urban, affordable housing remains vulnerable to damage and loss.

The Loma Prieta earthquake emphasized the complexity of the risk posed by urban earthquakes and validated our efforts to that time in countering complex risk with a program of comprehensive mitigation, preparedness and response planning. Loma Prieta spurred us to continue and intensify our efforts in both mitigation and preparedness, and in building an emergency response system capable of responding to the needs of Californians.

It is important to note that Loma Prieta was also the first regional earthquake to strike the state in more than 80 years. Ten Bay Region counties declared states of emergency as a result of the quake. Electrical power was lost to communities across the region. Communication was disrupted between Santa Cruz and Monterey counties on the Bay Region. Damage to the region's freeways and bridges triggered region wide congestion as commuters and businesses attempted to find alternative transportation routes to and from their jobs and markets. While the strong ground shaking lasted less than 15 seconds, the physical and economic effects of the quake continue with us today. Sixty-three people lost their lives, most in the collapse of a single structure -- the Cypress Viaduct in

Oakland. Nearly 3,800 people were hospitalized with injuries. The central business districts in Santa Cruz, Watsonville and Oakland were devastated by the collapse of post turn of the century unreinforced masonry buildings. More than 367 businesses were destroyed. Initial estimates were that the earthquake caused \$6 billion in damage and left 12,000 homeless. Replacing lost housing units became a major issue as the vacancy rate in the Bay Region was near 1%. While the state and federal governments have experience in providing interim housing in non-urban communities, the loss of urban single room occupancy housing in Oakland and San Francisco required the creation and implementation of new and innovative solutions. There were no estimates made of the long-term economic losses resulting from the quake, but their addition to the damage estimates would significantly escalate the \$6 billion figure.

In the aftermath of the earthquake, federal and state relief and recovery programs provided \$760,300,000 to 28,000 applicants. Aid included temporary housing assistance, Small Business Administration loans, grants to individuals and families and CALDAP loans. Five-hundred and seventy-four (574) applicants have submitted claims for response costs and costs to repair public facilities. To date, California and the Federal Emergency Management Agency have approved funding for \$915,540,390 and have obligated \$893,068,400 for 10,915 projects. In addition to damage claims, \$60 million in hazard mitigation grants are being made to jurisdictions in the region.

#### Issues for Recovery and Reconstruction

The reconstruction process is by its nature complex and protracted . Loma Prieta highlighted numerous policy and practice issues that continue to impact the public assistance program. These issues include a lengthy application and review process that includes definition of the projects, permitting and historical review and agreement on appropriate codes and standards to be applied to often complex engineering design solutions for the repair and retrofit of damaged structures. In addition, financing of the required local match to federal and state financing is often difficult.

California's concern with the prolonged reconstruction process is shared by the federal General Accounting Office (GAO) and Federal Emergency Management Agency (FEMA) who are currently



reviewing the project review process. In addition, in the aftermath of the Northridge earthquake and 1995 floods, the California Legislature expressed its concern about the processing of reconstruction assistance and augmented the staff of OES' Disaster Assistance Division to expedite application processing.

### The Lessons of Loma Prieta

In the seven years since the Loma Prieta earthquake, state and local governments have paid increasing attention to three key issues: First, to emphasize the importance of community preparedness and mitigation of hazardous buildings; second, to emphasize community preparedness; and third, to improve emergency response capabilities by developing comprehensive and standardized response management system.

These are the legacies of Loma Prieta.

### Expanded Preparedness and Hazard Mitigation Programs and Resources

In response to the damage and disruption resulting from the quake, OES' Earthquake Preparedness Program developed additional guidance materials and information for local governments intended to reduce damage and speed recovery. Materials included a manual for local government officials outlining the relief and recovery process and identifying critical decisions and resources for local governments (*Earthquake Recovery: A Survival Manual for Local Governments*); an instructional video tape and construction details to assist home owners in strengthening their homes and organize their communities (*An Ounce of Prevention: Strengthening Your Wood Frame House for Earthquake Safety, Organizing Your Neighborhood for Earthquake Preparedness*); guidance for hospitals and schools, identifying ways to reduce losses and respond more effectively (*Earthquake Preparedness Guidelines for Hospitals; Earthquake Ready: Preparedness Planning for Schools, Earthquake Preparedness Policy: Considerations for School Governing Boards, Earthquake Preparedness 101: Planning Guidance for Colleges and Universities*); and, guidance for local governments on means to finance mitigation (*Seismic Retrofit Incentive Programs: A Handbook for Local Governments*).



### Creation of an Urban Search And Rescue Capability

The collapse of the Cypress Viaduct posed unique problems for search and rescue personnel. How would a local government undertake and sustain rescue efforts in multiple collapsed structures after an urban earthquake. Based on the knowledge gained by OES personnel on the scene of the Cypress Viaduct in Oakland, OES developed the concept of the self contained interdisciplinary Urban Search and Rescue Task Force comprised of engineers, medical personnel, search and rescue experts and management support. Each Task Force is comprised of 62 members. There are currently eight USAR Task Forces as part of fire fighting agencies in California available to support local governments across the state. Additional Task Forces, funded by FEMA in other states are available to support disaster operations across the country

California's USAR teams have responded to numerous disasters including assisting at the bombing of the Murrah Building in Oklahoma City.

### Deployment of Enhanced Emergency Communication System and Management System

Loma Prieta illustrated the vulnerability of communication and information management systems in the Bay Region. Damage to the telecommunications system, loss of power, and the lack of redundancy combined with the high demand for communication created by the disaster, severely limited initial damage reporting and the state's ability to assess the impact of the disaster. An analysis of the state's needs for communication capability and information flow resulted in the development and installation of a satellite based communication system linking each county with the OES Regions and Sacramento. The Operational Area Satellite Information System (OASIS) now provides a robust voice and data communication network linking emergency management agencies across the state. Incorporated into OASIS is the Response Information Management System (RIMS) to transmit data on damage and requests for resources. As part of the development of OASIS, OES initiated development of concepts for standardizing information reporting and management based on the Incident Command System (ICS). Standardizing procedures and

organizational structure was well under way within OES by the end of 1990. In the aftermath of the 1991 Oakland East Bay Hills fire, our efforts to improve the emergency management system were spurred by legislation authored by Senator Petris. OES was directed to develop and implement the Standardized Emergency Management System (SEMS) by the end of 1996. We took the opportunity of SEMS implementation to formalize and incorporate OASIS as the communication backbone of a standardized network of emergency management linking local, regional and state agencies. By December of this year, SEMS utilizing OASIS and RIMS will be fully implemented in California.

In addition, OES and FEMA have developed computerized methods for estimating damage, injuries, victims made homeless, and economic loss from future earthquakes. These modeling tools have already proved their effectiveness by providing a better understanding of potential earthquake losses and in promoting mitigation by local governments. We will no longer have to wait for several hours for local governments, who may be overwhelmed by damage and primary response, to report damage. Early Post Earthquake Damage Assessment Tool (EPEDAT) developed by OES would provide emergency responders with estimated losses immediately after a damaging earthquake, speeding the mobilization of state and federal resources.

These and other efforts have paid dividends, particularly on the morning of January 17, 1994, in Northridge. Local and state agencies responded immediately, identified problems quickly and anticipated needed resources. California's law enforcement, fire, urban search and rescue and mutual aid systems responded immediately. These actions saved lives and reduced property damage. Within hours of the Northridge earthquake, local and state agencies had completed all essential life-safety and fire suppression operations, including the rescue of 29 people from damaged buildings and vehicles by members of six California USAR Task Forces.

We can take great pride in the steps taken in California to improve the emergency management system serving the state. But we must remember two central issues. First, emergency management is a continuum from mitigation of hazards and preparedness, through response to recovery. The

response to Loma Prieta was complete in the fall of 1989, but we continue today with the reconstruction. Second, we cannot become complacent by our success in responding to Loma Prieta and Northridge. Both quakes occurred at the edge of dense urban centers. Earthquakes in the center of the Bay Region on the Hayward fault or peninsula segment of the San Andreas faults would pose significant challenges to response and recovery for local and state government.

OES' primary mission is to respond to and support recovery from disasters. However, we continue to emphasize the critical importance of preparedness and mitigation. It is our hope that every citizen of California understands the risks of living in earthquake country and takes prudent steps to prepare, reduces hazards in their homes and work place, and supports the abatement of hazardous buildings and structures. What we all do now will determine the outcome of the next earthquake.



## Summary: Loma Prieta Earthquake Data

Location	10 miles NNE Santa Cruz
Magnitude	7.1
Felt Area	400,000 Square Miles
Deaths	63
Injuries	3,757
Homes Destroyed	1,015
Homes Damaged	23,406
Businesses Destroyed	367
Businesses Damaged	3,547
Private Property Loss (Est.)	\$3.3 Billion
Public Property Loss (Est.)	\$2.3 Billion
Homeless	12,000

### Individual Assistance Summary

	Applications	Approved	Amount
Temp. Housing	38,230	14,113	\$ 30,717,594
SBA Loans (Homes)	18,831	11,462	\$ 309,270,000
SBA Loans (Business)	6,753	3,484	\$ 253,057,700
IFG	38,813	28,113	\$ 43,441,101
CALDAP			\$ 95,210,209
Disaster Unemployment	1,790	1,386	\$ 1,968,440

### Public Assistance Summary

Applicants / DSRs	574 / 10,950
FEMA Eligible	\$ 681,280,314
State Eligible	\$ 235,228,576
FEMA Obligated	\$ 658,808,324
State Allocated	\$ 234,260,076
Projects Completed	3,056
Projects Under Construction	7,859



Governor's Office of  
Emergency Services

# Fact Sheet

(916) 262-1843

OCTOBER 12, 1994

## LOMA PRIETA EARTHQUAKE STATISTICAL UPDATE

**NOTE TO EDITORS/NEWS DIRECTORS:** The following information has been gathered by OES for your use in Loma Prieta Anniversary Stories. For details on specific programs, please contact the appropriate agency directly. Contact name and numbers are provided for your convenience.

### Statistical recap

Date/Time of Earthquake: October 17, 1989 5:04 p.m. PDT

Magnitude: 7.1

Aftershocks: The US Geological Survey reported that **more than 11,000 aftershocks** ranging from magnitude 1.0 to 5.4 occurred in the area between October 17, 1989 and October 12, 1994.

Earthquake-related deaths: 63 deaths as reported by county coroners: Alameda-43, Monterey-2, San Francisco-12, Santa Clara-1, Santa Cruz-5.

Injuries: 3,757 total injuries

Homes damaged: 23,408

Homes destroyed: 1,018

Businesses damaged: 3,530

Businesses destroyed: 366

Estimated dollar loss: \$5.9 billion

### Jurisdiction affected

Jurisdictions included in the Presidential Major Disaster Declaration were Alameda, Contra Costa, Marin, Monterey, San Benito, San Francisco, San Mateo, Santa Clara, Santa Cruz, and Solano counties; the cities of Tracy (San Joaquin County) and Isleton (Sacramento County).

### Damage Estimates by County

Following are the preliminary damage estimates made shortly after the earthquake. These numbers will not be revised.

County	Homes Damaged	Homes Destroyed	Businesses Damaged	Businesses Destroyed	Public-Private Damage Estimates
Alameda	2,765	20	397	16	\$1,472,461,880
Contra Costa	485	0	124	0	24,839,000
Marin	24	0	20	0	1,663,811
Monterey	341	19	48	11	117,736,000
San Benito	174	62	35	22	101,505,000
San Francisco	382	11	134	0	2,759,000,000
San Mateo	782	1	793	1	294,267,000
Santa Clara	5,124	131	364	6	727,700,000
Santa Cruz	13,329	774	1615	310	432,797,162
Solano	2	0	0	0	3,760,000
<b>TOTAL</b>	<b>23,408</b>	<b>1,108</b>	<b>3,530</b>	<b>366</b>	<b>\$5,935,729,853</b>

### Assistance to the Private Sector

As of June 30, 1994, a total of \$760,264,172 in state and federal funding has been approved for individuals, families, and businesses to assist them in recovering from the earthquake. In addition, \$4,224,604 in state and federal funds have been expended for crisis counseling programs.

Because of the earthquake-aggravated housing shortage, five temporary mobile home parks were established in Santa Cruz (3), San Benito (1), and Monterey (1) counties, for a total of 160 units.

The State Board of Control provided \$72 million in settlements for persons killed, injured, or suffering property damage due to the Cypress structure and Bay Bridge collapses.

Listed below are the specific programs made available to individuals, families and businesses affected by the earthquake and the dollar amounts approved as of September 26, 1994:

Temporary housing	\$ 30,717,594
Small Business Administration Loans	
Home/Personal Property	309,270,000
Business	253,057,700
Economic injury	19,752,100
Individual & Family Grants	46,060,055
State Supplemental Grants	4,228,074
Housing & Community Development Loans	
Owner	45,390,214
Rental	49,819,995
Disaster Unemployment	1,968,440
<b>Total</b>	<b>\$760,264,172</b>



### Assistance to the Public Sector

As of September 26, 1994, numerous city, county, and state repair and restoration projects had been determined to be eligible for state and federal reimbursement, for a total of \$664,006,759. Of that amount, the federal share was \$503,065,609. Cities, counties, and state agencies are reimbursed for eligible response costs and for repair and restoration of public property (buildings, roads, bridges, utilities) damaged or destroyed by the earthquake. Assistance to special districts and private nonprofit agencies is also included.

As of March 1994, approximately \$44 million in hazard mitigation grant program funds had been made available by FEMA for city, county, special district, and nonprofit agency earthquake hazard mitigation projects.

### Assistance from Volunteer Organizations

During the emergency period, the American Red Cross (ARC) sheltered 64,159 persons, served 642,785 meals, and operated various other assistance programs. The ARC obligated \$74.5 million for this disaster.

The Salvation Army spent \$6 million in Santa Cruz County and \$2 million in Watsonville for two housing complexes for displaced elderly persons; \$1 million for the Gateway Transitional Housing Facility in San Francisco; and \$500,000 for a central kitchen in San Francisco for mass feeding operations after earthquakes and other disasters.



**SEISMIC SAFETY COMMISSION**

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**Seismic Safety Commission Presentation to the  
Senate Committee on Housing and Land Use  
October 16, 1966**

**by  
Richard J. McCarthy  
Executive Director**

Actions Taken by the Seismic Safety Commission Since the Release of its  
Publication *The Northridge Earthquake: Turning Loss to Gain*:

## I. BACKGROUND

- *Turning Loss to Gain* document was the result of Governor's Executive order W-78-94 that directed the Commission to:
  - review the effects of the Northridge earthquake
  - coordinate a study of specific policy implications with particular attention to implications for seismic structural safety and land-use planning
- *Turning Loss to Gain* contained 168 recommendations that support four fundamental seismic safety goals in California:
  - Make seismic safety a priority
  - Improve the quality of construction
  - Reduce the risk from seismically vulnerable structures
  - Improve the performance of lifelines
- Recommendations were not "prioritized"

## II. CALIFORNIA AT RISK

- *California at Risk* presents the program required by the California Earthquake Hazards Reduction Act of 1986 (Gov. Code Section 8870 *et seq.*)
- This Act directs the Seismic Safety Commission to establish a series of five-year programs to reduce statewide earthquake hazards significantly by the year 2000.
- FEMA recognizes *California at Risk* as the State's Earthquake Hazards Mitigation Plan



- A collaborative effort is now underway to develop the third edition that will lead California earthquake risk reduction efforts into the next century. Major collaborative partners include:
  - Seismic Safety Commission
  - Governor's Office
  - State and Consumer Services Agency
  - Office of Emergency Services
- The challenge is to incorporate into *California at Risk* lessons from the following earthquakes:
  - Kobe (1995)
  - Northridge (1994)
  - Landers/Big Bear (1992)
  - Cape Mendocino (1992)
- The revised document will contain "initiatives" (some of which are contained in *Turning Loss to Gain* report) that set forth priorities, project schedules, and activities and will be presented in the following 10 proposed categories:
  1. Economics
  2. Existing Buildings
  3. New Construction
  4. Lifelines
  5. Geology
  6. Emergency Response
  7. Recovery
  8. Research and Technology
  9. Education and Information
  10. Land Use
- Through a cooperative effort with the partners, policy statements will be drafted and approved by the Commission.
- Finally, all priority initiatives within each category will be "short listed" and overall statewide priority initiatives emphasized.

### III. POST REPORT COMMISSION LEGISLATION

- Of the Commission's 168 recommendations in *Turning Loss to Gain*, 26 fell under the purview of this Committee. Attempts have been made to implement 14 of the recommendations and we have had varying degrees of success on 7 of the recommendations.
- The greatest hindrance that the Commission has faced with respect to those bills is the fact that they would create state mandated local programs. Although local government may not oppose these measures, we have encountered resistance from the state legislature because of the potential impact that these proposals would have on the state budget.

- Therefore, the Commission has decided to re-evaluate its approach and develop a strategic plan for the adoption and implementation of recommended earthquake policies and programs. The strategic plan will reflect the priority recommendations of the state's five year plan (*California at Risk*) but the Commission's focus will be much broader. No longer will the Commission place nearly all of its emphasis on the state legislative arena, but will work at the local level, through local government meeting agendas, pursue administrative and regulatory changes where possible, and initiate legislation as needed.
- In 1997, the Commission may attempt to implement the recommendations for updating local safety elements in a handful of counties as well as help local government implement a plan to ensure essential services buildings have reliable backup power and emergency water supplies.
- At the state level, the Commission may sponsor legislation that requires: continuing education for design professionals, engineers, architects, and geologists; that CalOSHA's standards board develop, adopt and disseminate earthquake safety regulations to employers; and that all Homeowners and Commercial Property Owners are informed of commonly found seismic weaknesses of homes and commercial buildings, not just those built before 1960 and 1975, respectively.
- The Commission will be creating a sub-committee dedicated solely on the "economics" of earthquakes and "financial incentives" to encourage retrofit and mitigation. It is premature to introduce legislation on incentives without having the proper professionals and expertise to provide guidance. The Commission is proposing a new committee will consist of the banking and finance industry, the insurance industry, building owners, the real estate industry, a tax specialist (possibly someone from the FTB), an economist (possibly the Governor's Chief Economist), the head of the Department of Finance, and possible legislators or their consultants to help develop financial incentive proposals that are legislatively viable.

#### IV. SUMMARY

1. Policy questions presented in the Committee's background paper "mirrors" questions and challenges involved in updating *California at Risk*.
2. Earthquake risk reduction efforts in California are at a unique point in time. A rare opportunity exists to develop an overall strategic plan that will focus the state's efforts towards reducing earthquake risk. A well crafted strategic plan will eliminate duplicative effort, reduce cost, and accelerate the timetable for meeting defined goals.
3. The Commission requests Committee suggestions on how to best to work with the Legislature to develop cost-effective seismic safety legislation.
4. This committee should become familiar with *California at Risk* which will be complete by April, 1997 (earthquake preparedness month), and seek implementation of the report's priority initiatives.





SENATE COMMITTEE ON HOUSING AND LAND USE TESTIMONY  
TRACI STEVENS, DEPUTY SECRETARY  
STATE AND CONSUMER SERVICES AGENCY  
OCTOBER 16, 1996

Mr. Chair and members, my name is Traci Stevens, and I am the Deputy Secretary for Legislation for the State and Consumer Services Agency. With me is Mr. Harry Hallenbeck, who is the Directory of Seismic implementation for our Agency and representatives from the Department of Conservation and the Division of Mines and Geology. I appreciate the opportunity to be here before you to discuss our role in coordinating Seismic implementation for the Administration.

After the Seismic Safety Commission concluded their report "Turning losses into Gains", the Governor designated our Agency as the entity to coordinate individual departmental responses to the 168 recommendations. This project was spearheaded by Harry Hallenbeck. Harry has been in contact with the all departments and agencies over the past six months who have a role in seismic safety in order to determine their input regarding the 168 recommendations.

We have contained the summary comments specific to the recommendations within your purview, since the complete summary is quite lengthy. In the interest of the committee's time I will not discuss each response, but will talk about our successes and future goals. For your convenience, however, the summary is attached for your review.

Out of the 26 recommendations, the affected departments rated the recommendations as follows: 3-High, 10-Medium, and 13 as Low priorities. Please remember that the departments rated these recommendations themselves and this does not reflect further agreement by the Administration. As Mr. McCarthy has stated previously, we are in the process of reviewing all recommendations and providing a coordinated overall policy direction for the entire state. Rather than trying to address seismic implementation in a piecemeal approach., we are delighted to be working closely with the Commission and all of the affected Departments and Agencies to build consensus and a positive working environment for future success.

One of our proud successes was SB 1864 (Alquist) which this Agency and the Seismic Safety Commission co-sponsored which has authorized and committed matching funds in the amount of \$2 million per year for 5 years in order to secure the National Center for Earthquake Engineering and Research in California. We are hopeful that our pending proposal to the National Science Center will be successful.

E/W

Additionally, the California Building Standard Commission has received preliminary approval of a \$200,000 grant will allow the Commission to update the Historic Building Code so it can be interpreted at the local level as part of the Title 24 development on a consensus environment.

WORKS IN PROGRESS INCLUDE::

- \* The retrofit on state building and local emergency facilities included in the proposition 122 bond funds. \$250 million. (Attached is the fiscal display.)
- \* Retrofitting of roads and bridges. \$2 Billion in bond funds.
- \* Pending FEMA grant to analysis building codes on a performance basis versus the minimal health and safety basis which we now see.
- \* Mapping of seismic hazards throughout the state.

On that final note, I would like to allow the Division of Mines and Geology to discuss their most recent maps with you.

Thank you for your time.



Sen Hearing Item #

Number Assigned to Recommendation by SSI

Recommendation Synopsis	Prime Agency		Agency Responses		Activity Exists	State Cost	Benefit		Administration Response		
	Resp	Priority	Support	Neutral			Oppose	Life		Econ	Cat
1 45 General Plans to List Building Type Hazards	COPR	Low		CYA	HCD COPR	N	\$15,000,000	Unk	Unk	F	LEGIS
2 138 Legislation Review Safety Element @ 5 yrs	CDMG	Low		CYA	RA/CDMG HCD	Y	\$1,700,000	Unk	Unk	A	Cont
3 139 Legislation Mandate Safety Element Review	CDMG	Low	CYA RA/CDMG			Y	\$100,000	Unk	Unk	P	Cont
4 140 Legislation Vulnerability Existing Buildings	COPR	Low	CYA HCD*	RA	RA/CDMG COPR	N	\$1,800,000	Unk	Unk	F	LEGIS - DUP OF #45
5 161 Legislation Local Gen Plans Post EQ Recov	OES	Med	CYA		COPR	N	\$10,000,000	Unk	NONE	F	LEGIS FRUITLESS
6 146 Legislation Geo Reports all Major Subdiv	CDMG	Med		CYA	HCD RA/CDMG	N	Undetermined	Unk	Unk	F	UNFUNDED
7 151 Legislation re Land Use Laws	LEG	Med	CDMG CYA			N	Undetermined	Unk	Unk	F	LEGIS
8 159 Legislation Redev Agency Define "Blight"	LEG	Low		CYA	HCD COPR	N	\$0	Unk	Unk	F	LEGIS
9 28 Plan Checking by Licensed Professionals	DCA	High	CYA BPELS CDC		HCD	Y	\$50,000	High	Neutral	F	Required by Existing Law
10 30 Plan Checkers & Inspectors to be Certified	LEG	Med	HCD DSA			N	\$0	Low	Low	F	Costs would be minor.
11 35 CBSC Responsible for All Seismic Code	CBSC DSA	High	DSA HCD CBSC	CYA	CSU	N	\$332,000	Med	Neu	F	
12 36 CBSC to Accomplish within One Year	CBSC	Med	HCD CBSC	CYA		N	\$25,000	Unk	Neutral	F	
13 46 Adopt Mandatory Mitigation Program	CBSC	High	CYA CDC DSA		HCD	N	\$1,200,000	Unk	Unk	F	LEGIS
14 48 Revisit 1986 URM Law and Update	LEG	Low	CYA			N	\$100,000	Unk	Unk	F	LEGIS
15 49 Disclosure of Seismic Risk at Time of Sale	LEG	Low	CYA			N	\$0	Unk	Unk	F	LEGIS
16 50 Removal of Warning Placards Allowed	LEG	Low	CYA			N	\$0	Unk	Unk	F	LEGIS
17 51 Warning Placards and Seismic Risk Plans	CalOSHA	Low	CYA		CalOSHA	N	Undetermined	Low	Low	F	LEGIS
18 59 Require Earthquake Resistant Bracing	HCD	Med		CYA	HCD	N	\$0	Unk	Unk	F	
19 148 Legislation A-P Act Applies to Public Owned	CDMG	Med	CYA CDMG			N	Undetermined	Unk	Unk	F	LEGIS
20 70 Retrofit Pre-1986 ES Bldgs as Needed	DSA	Low	DSA CYA			N	\$0	Unk	Unk	F	LEGIS
21 73 Support Bond Measure to Accomplish ES	LEG	Low	CYA			N	\$0	Unk	Unk	F	LEGIS
22 74 Amend ESA to Include City Halls, etc.	LEG	Low		CYA		N	\$100,000	Unk	Unk	F	LEGIS
23 110 Mandate Auto Shutoff at Service Entry	HCD	Med		CYA	HCD	N	\$100,000	Unk	Unk	F	
24 141 Legislation Review SHMA Maps	CDMG	Low	CYA		RA/CDMG	Y	\$0	Unk	Unk	A	Cont (Budgeted)

Activity Exists: 'Y' = Yes, 'P' = Partially, 'N' = No Category: 'A' = Already Being Done, 'E' = Easily Accomplished w/ Minimal Cost, 'F' = Further Study Required  
 Comments: 'Cont' = Continue Existing Policy and/or Activity, 'Incr' = Increase Existing Policy and/or Activity, 'Disc' = Discontinue Existing Policy and/or Activity



Sen Hearing Item #

Number Assigned to Recommendation by SSI

Recommendation Synopsis

Sen Hearing Item #	Number Assigned to Recommendation by SSI	Recommendation Synopsis	Prime Agency Resp		Agency Responses		Activity Exists	State Cost	Benefit		Administration Response		
			CDMG	Med	Support	Neutral			Oppose	Life Econ		Econ	Cat Priority
25	147	Legislation re Designate Active Fault Zones	CDMG	Med	CYA		RA/CDMG	N	Undetermined	Unk	Unk	F	Same as #11 SUNSET??
26	155	Legislation A-P Act, SHMA Apply to All Sites	CDMG	Med	CYA		COPR	N	Undetermined	Unk	Unk	F	LEGIS

Activity Exists: 'Y' = Yes, 'P' = Partially, 'N' = No      Category: 'A' = Already Being Done, 'E' = Easily Accomplished w/ Minimal Cost, 'F' = Further Study Required  
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 STATE and CONSUMER SERVICES AGENCY - SEISMIC SAFETY IMPLEMENTATION

## ATTACHMENTS

- I Summary of Recommendations by the Departments regarding priority rating.
- II Individual Department/Agency responses to Seismic Safety Commission "Turning Losses Into Gains" Report.
- III Prop. 122 Bond Fund Fiscal Outline
- IV SB 1490 Veto Message





DEPARTMENTAL/AGENCY RESPONSES TO SEISMIC SAFETY

COMMISSION "TURNING LOSSES INTO GAINS" RECOMMENDATIONS .



**(1) Recommendation #45**

*Legislation be enacted to require that, by the year 2000, local general plan safety elements contain a generalized description of all typical building types and vintages in the community's neighborhoods, with a special emphasis on those vulnerable to collapse from seismic hazards, and a plan to mitigate the risk from these structures.*

**Current Law/Practice:**

Current law allows voluntary identification and mitigation of unreinforced masonry buildings.

**Analysis of Proposed Law/Practice:**

Per Governor's Office of Planning & Research (COPR): This proposal would be a local mandate, reimbursable from the State. Few if any, of the 526 city and county safety elements currently contain such an inventory and mitigation program. The State would incur implementation costs easily exceeding \$15 million (assuming an average cost of \$30,000 for the inventory, policy preparation, and environmental review). Meeting a year 2000 deadline, particularly in the larger cities, would be practically impossible.

COPR does not support this recommendation. This program would duplicate the voluntary identification and mitigation of unreinforced masonry buildings authorized under current law. It would create an open-ended reimbursable mandate.

**Action Taken (if any):**

SSC sponsored SB 1874 (Alquist, 1996) to revise the contents of local safety elements; however, this recommendation was not part of the bill which died in the Senate Appropriations Committee.



**(2) Recommendation #138**

*Legislation ben enacted requiring review of the safety element of general plans every five years to incorporate new information; the information in maps prepared under the SHMA should be incorporated within one year of the date final maps are provided to local jurisdictions.*

**Current Law/Practice:**

Existing law only requires that SHMP information be used when safety elements are updated, but does not mandate an update when information becomes available.

**Analysis of Proposed Law/Practice:**

Per Resources Agency: A 1985 CDMG survey of safety elements determined that approximately 40 percent had not been modified since they were first adopted in the early 1970's. Regular revision of safety elements could improve mitigation of seismic hazards by assuring that land-use decisions are based on the most recent hazards information. Existing law only requires that SHMP information be used when safety elements are updated, but does not mandate an update when information becomes available. The best time to update an element would be soon after new maps are issued.

Mandating safety element updates may be an unfunded state mandate. If seismic hazard zoning is accelerated, the local updates could be limited to the approximately 350 jurisdictions that would receive SHMP maps during that process. A one-time local upgrade of the earthquake portion of the safety elements associated with the new zones would cost approx. \$1.7 million.

If the information obtained in the seismic hazards mapping is to be of use to the local governments, the safety elements should be updated to mitigate for the seismic hazards when local governments make land-use decisions. However, CDMG does not support this recommendation since it is an unfunded state mandate.

**Action Taken (if any):**

The Dept. of Conservation has proposed alternative legislation to the SSC that would require that the chairs of elected Boards and Councils acknowledge in writing their receipt of the seismic hazard zone maps to the State Mining & Geology Board, confirming their receipt and pledging that the zones will be incorporated in the safety element of their general plans at the earliest opportunity and the local govt. will fully comply with the statutory requirements governing the use of such maps. The DOC feels that this would not incur any additional expense for local government and yet it would provide reasonable assurance of compliance.

SSC sponsored SB 1874 (Alquist, 1996) to address this issue; however, this recommendation was not part of the bill which died in the Senate Appropriations Committee.

No other action has been taken on this recommendation.

**(3) Recommendation #139:**

*Legislation be enacted to make the existing optional CDMG review of safety elements mandatory for CDMG.*

**Current Law/Practice:**

(Information being researched, but not available as of the hearing date)

**Analysis of Proposed Law/Practice:**

Per Resources Agency: Review of safety elements as they are updated would help to ensure that the information is accurately interpreted, current and reasonable complete. It would also minimize the potential for "conceptual gaps" that often hinder the mitigation process. The cost of review would depend upon the number of safety elements that are updated each year.

If each city and county is required to update its safety element when the seismic hazard maps are released for their jurisdiction, CDMG would be required to review approximately 20 safety element revisions each year. The cost would be near \$100,000 annually. (CDMG currently has only a fraction of one person year available for safety element review.)

CDMG should review all safety element revisions that utilize new CDMG seismic hazard zones if funding is available.

**Action Taken (if any):**

SSC sponsored SB 1874 (Alquist, 1996) to address this issue; however, this recommendation was not part of the bill which died in the Senate Appropriations Committee.

**(4) Recommendation #140:**

*Legislation be enacted to require that the safety elements of general plans address seismic vulnerability of existing building stock, or inventory, and contain risk-mitigation strategies. Description of the building stock should be included in enough detail to support the risk-mitigation strategy.*

**Current Law/Practice:**

(Information being researched, but not available as of the hearing date)

**Analysis of Proposed Law/Practice:**

Per Governor's Office of Planning & Research (COPR): This may be a duplicate of Recommendation #45 which states:

*Legislation be enacted to require that, by the year 2000, local general plan safety elements contain a generalized description of all typical building types and vintages in the community's neighborhoods, with a special emphasis on those vulnerable to collapse from seismic hazards, and a plan to mitigate the risk from these structures.*

This proposal would be a local mandate, reimbursable from the State. Few, if any of the 526 city and county safety elements currently contain such an inventory and mitigation program. The State would incur implementation costs easily exceeding \$15 million (assuming an average cost of \$30,000 for the inventory, policy preparation, and environmental review). Meeting a year 2000 deadline, particularly in the larger cities would be practically impossible.

COPR does not support the recommendation. This program would in some ways duplicate the voluntary identification and mitigation of unreinforced masonry buildings authorized under current law. It would create an open-ended reimbursable mandate.

**Action Taken (if any):**

The SSC sponsored SB 1874 (Alquist, 1996) to revise the contents of local safety elements, this recommendation was not part of the bill which died in the Senate Appropriations Committee.

No action has been taken on this recommendation.



**(5) Recommendation #161:**

*Legislation be enacted to require local general plans and emergency plans to address post-earthquake recovery and rebuilding.*

**Current Law/Practice:**

Per Gov's Office of Planning & Research (COPR): Current law allows general plans to be amended if necessary to reflect the changed environment which may exist after an earthquake.

**Analysis of Proposed Law/Practice:**

Per COPR: General plans are intended to be comprehensive policy statements for the long-term development of the community. Post earthquake recovery and rebuilding activities are generally short-term. A general plan cannot accurately address post-earthquake rebuilding activities; however, under current law, it may be amended if necessary to reflect the changed environment which may exist after an earthquake. Attempting to predict those general plan changes needed given the limited ability to predict the extent or location of damage would be fruitless.

COPR does not believe that legislation is needed relative to addressing recovery and rebuilding in general plans. This proposal would be a local mandate, reimbursable from the State and would not be cost effective.

**Action Taken (if any):**

The SSC sponsored SB 1874 (Alquist, 1996) to revise the contents of local safety elements, this recommendation was not part of the bill which died in the Senate Appropriations Committee.

No action has been taken on this recommendation. No other bills or legislation have been introduced.

**(6) Recommendation #146:**

*Legislation be enacted to amend the subdivision Map Act to require that geologic and geotechnical reports addressing seismic hazards be required for all major (five lots or more) subdivisions unless information is already available or until superseded by SHMA maps and that the reports be reviewed by local government staffs or consultants with appropriate credentials.*

**Current Law/Practice:**

(Information being researched, but not available as of the hearing date)

**Analysis of Proposed Law/Practice:**

Per Resources Agency: This recommendation should not be implemented at this time as proposed. Although the proposed revision of the Subdivision Map Act would reduce future earthquake losses, it is not focused on the hazards identified by the SHMP as some of the other commission recommendations which would have broader benefits.

Per CA Division of Mines & Geology (CDMG): This recommendation proposes that the Subdivision Act be amended to require geologic and geotechnical reports for any project of five or more lots. This is an unfunded State mandate to local government. The CDMG does not support this recommendation in its current form. There are some regions where a subdivision requirement of this type might identify significant hazards that should be mitigated. However, it would be very difficult to craft legislation that would identify those areas. The policy would probably be disputed by the local governments which would object to their jurisdictions being included and others not.

Per Gov's Office of Planning & Research (COPR): This recommendation, as it is presently phrased, creates a mandate that covers the entire state, regardless of whether or not a local seismic hazard truly exists. The Alquist-Priolo Earthquake Fault Zoning Act currently requires the preparation of a geologist's report for subdivisions within specified earthquake hazard zones, via Public Resources Code Section 2623. Accordingly, implementing this recommendation would effectively broaden the geographic scope of an existing requirement; however, CDMG would have no objection to couching the proposal's language to create a new enabling authority for local governments, so as not to be misconstrued as creating a new mandate.

**Action Taken (if any):**

CDMG believes that the Seismic Hazard Mapping Act will fulfil this need by issuing zone maps requesting special investigations before development within them.

No action has been taken on this recommendation. No bills or legislation have been introduced.

**(7) Recommendation #151 :**

*Legislation be enacted to amend land use laws to require state and local agencies to make specific findings regarding the acceptability of inundation hazards before approving development of critical facilities (for example: hospitals, schools, emergency response facilities, hazardous material storage, and sewer treatment plants) within potential inundation areas.*

**Current Law/Practice:**

Per CA Div. of Mines & Geology (CDMG): To our knowledge there is no consistent set of statewide maps showing flood inundation areas due to seismically induced dam failures. In CDMG's geologic hazards review project, therefore, no routine systematic review is made of the potential hazard of flood inundation from a seismically caused dam failure. However, in those cases where a project is known to lie downstream from a major dam, it is called to the attention of the Division of Safety of Dams, who comment on the project when asked. Thus, it is probable that their review process could miss some projects build distant from dams but still within inundation areas.

EIR's for critical facilities and large developments are currently reviewed to see if the hazard due to inundation from potential winter or spring flooding has been addressed. For this purpose, FEMA Flood Insurance Rate Maps are used. If the proposed project is in a coastal area, the hazard from seismic sea waves (tsunamis) is reviewed and commented upon. Tsunami run up maps (from Houston, U.S. Army Corps of Engineers, Campbell, NOAA and others) are used as a regional source while a variety of site specific maps are used where more detail is required. These are used for tsunamis from distant earthquakes. Little literature exists for tsunamis caused by close earthquakes.

**Analysis of Proposed Law/Practice:****Action Taken (if any):**

No action has been taken on this recommendation. No bills or legislation have been introduced.



**(8) Recommendation #159:**

*Legislation be enacted to add to the definition of "blight," when designating a redevelopment project area, those structures deemed by the local jurisdiction to pose an unacceptable risk of collapse in earthquakes.*

**Current Law/Practice:**

(Information being researched, but not available as of the hearing date)

**Analysis of Proposed Law/Practice:**

Per Governor's Office of Planning & Research (COPR): This recommendation could have severe ramifications for historic resources by encouraging their removal through redevelopment activities. The loss of historic structures can have a detrimental effect on the cultural and aesthetic fabric of the state. If carried through, this recommendation should be limited to projects which would aid the reuse/rehabilitation of such structures and limit their removal.

**Action Taken (if any):**

Assembly Bill 189 (Hauser, 1995) addresses this issue. It was signed by Governor Wilson - Chapter 186, Statutes of 1995.

**(9) Recommendation #28**

*Legislation be enacted to make structural plan checking of engineered buildings an act requiring professional licensing.*

**Current Law/Procedure:**

Per Board of Registration for Professional Engineers and Land Surveyors (BPELS): The opinion of our legal counsel confirmed that current law already makes structural plan checking of engineered plans an act which requires professional licensure.

Dept. Housing & Community Development states that AB 717 (Ducheny/Hauser, 1995), which was signed into law (Chapter 623 of 1995) on October 5, 1995, already requires this. (However, this law only applies to those hired by local agencies, except fire protection services, and does not apply to private firms.)

**Analysis of Proposed Law/Practice:****Action Taken (if any):**

BRPELS adopted Policy Resolution 95-01 clarifying that the dictates of this item are required by existing law. The Board is also working with the CA Building Officials Association (CALBO) and local agencies to publicize this information and develop a program of education and enforcement to assure compliance in the future.

The SSC sponsored Senate Bill 914 (Alquist, 1995) addressed this issue but died in the Senate Housing & Land Use Committee. (A February 1995 opinion by the Attorney General, acting on behalf of the Department of Consumer Affairs, concluded that license engineers and architects must conduct plan checks. Because the legal opinion made the bill moot, Senator Alquist dropped SB 914.)

**(10) Recommendation #30:**

*Legislation be enacted to require building inspectors and public and private plan checkers to be trained and certified by nationally recognized organizations and subject to continuing education requirements by recognized organizations in their areas of competence. Inspectors and plan checkers should be restricted from inspecting and checking plans beyond their areas of certification and competency.*

**Current Law/Practice:**

(Information being researched, but not available as of the hearing date)

**Analysis of Proposed Law/Practice:**

Information being researched, but not available as of the hearing date)

**Action Taken (if any):**

The SSC, CALBO and BIA co-sponsored AB 717 (Ducheny/Hauser, 1995), which was signed into law (Chapter 623 of 1995) on October 5, 1995, already requires this. (However, this law only applies to those hired by local agencies, except fire protection services, and does not apply to private firms. It also states that the local agencies determine their own certification requirements.)



**(11) Recommendation #35:**

*Legislation be enacted to designate CBSC as the entity responsible for the adequacy of the seismic safety codes and standards for all buildings in California. CBSC should ensure that building codes and their administration meet the state's acceptable levels of seismic risk through various actions, including but not limited to:*

- *Ensuring the adequacy of existing and future seismic safety requirements in the model codes and state amendments.*
- *Developing and adopting new seismic safety requirements for amendments to the building code for statewide applications.*

**Current Law/Practice:**

DSA currently develops structural and seismic building code language (administrative and technical) for State-owned buildings and for K-12 and community college buildings. DSA is also responsible for accessibility codes for all public buildings.

**Analysis of Proposed Law/Practice:**

Per DSA: This recommendation would increase the structural and seismic responsibility for development and/or interpretation of the code as applicable to other public and private buildings. It is important to recognize that even with local building officials being responsible for enforcement, they require continual interpretation of the intent of the code from the agency responsible for its development and adoption. This could add significant workload over DSA's current responsibility. Many State agencies would be involved in the development of any new code responsibility.

Per CBSC: Under current legislative authority, the CBSC could not adopt standards that would require the responsibility identified in this recommendation. Additional statutory authority would be needed because it would require CBSC to assume two new responsibilities: 1) Evaluate and validate existing and future seismic provisions in both the model codes and California amendments. 2) Develop and adopt new seismic safety requirements for statewide application. CBSC would also need additional staff with the necessary technical expertise.

**Action Taken (if any):**

DSA is not currently working on this recommendation.

CBSC has submitted a grant application under the FEMA funded OES Hazard Mitigation Grant Program to support this recommendation; however, no legislator has introduced a bill to assign this authority to the CBSC. Prompted by the failure of "steel moment welds" in buildings during the Northridge Earthquake, CALBO sponsored and the Governor signed AB 3772 (Ducheny, 1996) which permits the CBSC to adopt emergency regulations outside of the regular cycle for adopting building codes. The proposed adoption of a nationwide building code in 1999 forces California officials to consider whether a state agency should ensure that the new national standards account for California's special earthquake needs.

**(12) Recommendation #36:**

*Legislation be enacted to authorize CBSC to establish a task force including other affected and interested agencies and organizations to develop plans to fulfill this responsibility within one year of the above legislation.*

**Current Law/Practice:**

(Information being researched, but not available as of the hearing date)

**Analysis of Proposed Law/Practice:**

Per CBSC: This is a companion recommendation to expanding the Commission's role in developing seismic standards for statewide application. This is an appropriate method to develop the program.

**Action Taken (if any):**

No legislator has introduced a bill.

The CBSC has a Seismic Safety Committee which has applied to FEMA for a federal grant to create a task force to write and implement a performance-based code. The CBSC expects an answer from FEMA later this fall.

**(13) Recommendation #46:**

*Legislation be enacted to require state and local building code enforcement agencies to identify potentially hazardous buildings and to adopt mandatory mitigation programs by the year 2000 that will significantly reduce unacceptable hazards in buildings by the target year of 2020.*

**Current Law/Practice:**

The Dept. Of Housing and Community Development states that this is a duplication of Government Code Sections 8875.1 and 8872.2 and Health & Safety Code Section 17922.2

**Analysis of Proposed Law/Practice:**

Per CBSC: As this is a legislative activity, CBSC believes it is best left with the SSC. Under the CBSC's current legislative mandate, they do not have the authority to address the issue.

**Action Taken (if any):**

No legislator has introduced a bill; however, SB 597 (Alquist, 1992) appropriated \$320,000 to the State Architect to prepare seismic retrofit guidelines and standards by 1/1/96. SB 597 also required the CBSC to adopt these standards by 7/1/97.



**(14) Recommendation #48:**

*The Legislature revisit the state's 1986 Unreinforced Masonry (URM) Law and consider appropriate actions to address the inequities and the public's continuing exposure to risk that have resulted from the failure of a significant number of local governments to comply with the intent of the law so that approximately half of the state's URM buildings remain un-strengthened.*

**Current Law/Practice:**

(Information being researched, but not available as of the hearing date)

**Analysis of Proposed Law/Practice:**

Information being researched, but not available as of the hearing date)

**Action Taken (if any):**

No legislative committee has held the oversight hearing. The SSC believes that about 90 percent of the affected cities have identified URM buildings but only about 30 percent of those buildings have been reinforced.

The Senate Housing and Land Use Committee held an interim hearing on "Earthquake Safety & Building Codes" on 11/2/95. No legislation resulted from this recommendation.

**(15) Recommendation #49:**

*Legislation be enacted to require owners of potentially hazardous buildings to disclose seismic risk to potential buyers at the time of sale, to lenders, and to tenants on entering into or renewing leases, or when they relocate within a building.*

**Current Law/Practice:**

Although sellers are required to give buyers copies of the "Homeowner's Guide to Earthquake Safety" and the "Commercial Property Owner's Guide to Earthquake Safety", there is no similar law requiring notice to lenders or lessees:

Residential Property - Residential property owners must disclose to buyers all known material defects and deficiencies to the prospective buyer using a prescribed form entitled "Residential Earthquake Hazards Report" developed by the Seismic Safety Commission. If the house was built before 1960, a further requirement of delivering a copy of the booklet, *The Homeowner's Guide to Earthquake Safety*, must be made to the prospective buyer in addition to completion of the prescribed form. (See attached.)

Commercial Property - Commercial property owners of buildings constructed before 1975 with precast (tiltup) concrete or reinforced masonry walls and wood-frame floors or roof, or if it has unreinforced masonry walls, must give a copy of *The Commercial Property Owner's Guide to Earthquake Safety* to the prospective buyer along with a completed form entitled "Commercial Property Earthquake Weakness Disclosure Report" developed by the Seismic Safety Commission. (See attached.)

**Analysis of Proposed Law/Practice:**

The Seismic Safety Commission would like to additionally require owners to include pertinent information about the risks of damage, ways to reduce risk and the benefits, costs and limitations of seismic retrofits.

**Action Taken (if any):**

Governor Wilson vetoed SB 1490 (Rogers, 1996) which would have required design professionals to explain the seismic standards of the CA Building Standards Code to their clients. Although he called additional disclosure "a laudable goal," the Governor concluded that "it simply makes no sense to impose this requirement on every...project."

**(16) Recommendation #50:**

*Legislation be enacted to allow the warning placards required by existing law to be removed from potentially hazardous buildings that have been retrofitted in substantial compliance with Uniform Code for Building Conservation, Appendix Chapter 1, provided that the disclosures in the preceding recommendation take place.*

**Current Law/Practice:**

(Information being researched, but not available as of the hearing date)

**Analysis of Proposed Law/Practice:**

(Information being researched, but not available as of the hearing date)

**Action Taken (if any):**

No legislation has been introduced. No action has been taken on this recommendation.



**(17) Recommendation #51:**

*Legislation be enacted to require owners and business operators to include warning placards at the entrances to hazardous buildings of all types, as well as seismic risk management and response plans as part of their overall emergency plans for safety in the workplace.*

**Current Law/Practice:**

(Information being researched, but not available as of the hearing date)

**Analysis of Proposed Law/Practice:**

Per CalOSHA: CalOSHA has no jurisdiction over building owners, only employers. Not all building owners are employers and most building owners are not resident owners. This recommendation is better handled by the CBSC and the local building inspection agency, be it city or county. The employer has no control over the building owner regarding signing or placarding.

Per CBSC: If the CBSC was given the authority to require this of property owners, the rule making activity associated with the effort could be done as part of the annual code adoption cycle. CBSC agrees that this has low economic and life benefits and rates the recommendation as a low priority.

**Action Taken (if any):**

No legislator has introduced a bill. No action has been taken on this recommendation.

**(18) Recommendation #59:**

*Legislation be enacted to require the installation of Housing and Community Development (HCD) approved earthquake resistant bracing systems or other systems allowed by SB 750 (Roberti) on existing mobile homes when ownerships are changed or when homes are relocated.*

**Current Law/Practice:**

(Information being researched, but not available as of the hearing date)

**Analysis of Proposed Law/Practice:**

Per Dept. of Housing and Community Development (HCD): This recommendation could result in a total loss of equity for the owners of older manufactured homes. There are approximately 50,000 used manufactured homes sold annually and the cost of the recommendation is estimated to be \$5,000 per home. This would result in either a cost or equity loss of \$250 million annually for manufactured homeowners.

This recommendation is premature and fails to recognize the decision of the Legislature and the Governor in enactment of Chapter 240 of the 1994 Statutes (SB 750, Roberti) that new installation requirements for manufactured homes would not be retroactively applied--at great expense to homeowners.

Legislation would be required to implement this recommendation; however, HCD does not recommend such legislation.

**Action Taken (if any):**

The Governor signed SB 750, Roberti (Chapter 240, 1994 Statutes) as emergency legislation in response to the inadequacies of manufactured housing installations to resist the horizontal forces of wind and earthquake. As amended, this legislation would have required HCD certified Earthquake Bracing Systems (ERBS) to be installed on all manufactured homes in CA. Amendments considered would have implemented the SSC's recommendations for ERBS installations for new homes, at the time of sale of a used home or reinstallation of a used home. The bill was amended to address installations and reinstallations only.

No other legislation has been introduced; however, this issue may appear when HCD convenes a task force under SB 1704 (Craven, 1996) to draft a "transfer disclosure statement" for mobile homes.

**(19) Recommendation #148:**

*Legislation be enacted to apply the Alquist-Priolo Act to publicly owned facilities, critical facilities, and lifelines, including public utility pipelines and facilities in which hazardous materials are used or stored, and to provide for alternative mitigation measures appropriate to lifelines.*

**Current Law/Practice:**

(Information being researched, but not available as of the hearing date)

**Analysis of Proposed Law/Practice:**

The Dept. of Conservation believes that this is a desirable requirement that would improve mitigation of earthquake hazards. However, this should be accomplished by changes in the codes regulating public utilities other than the Public Resources Code requirements for local government and land use.

**Action Taken (if any):**

The SSC sponsored SB 1720 (Alquist) which died in the Senate Toxics and Public Safety Management Committee.



**(20) Recommendation #70:**

*Legislation be enacted to require state and local agencies to review all pre-1986 essential services facilities for their ability to function after earthquakes and that those found deficient be retrofitted.*

**Current Law/Practice:**

(Information being researched, but not available as of the hearing date)

**Analysis of Proposed Law/Practice:**

DSA believes this should be an Office of Emergency Services function.

**Action Taken (if any):**

In 1994, the SSC sponsored SB 1953 (Alquist, 1994) and the Governor signed it into law (Chapter 740, 1994 Statutes). The bill requires the Office of Statewide Health Planning and Development to adopt regulations for pre-1973 hospitals and then conduct compliance inspections.

In 1996, the SSC sponsored AB 3184 (Cortese, 1996) which would have required hospitals and other essential services buildings to have reliable emergency power and water sources. The Cortese bill died in the Assembly Health Committee.

**(21) Recommendation #74:**

*A general obligation bond measure be placed on the 1996 ballot to fund a state and local matching grant program or other funding mechanism to carry out the recommendations in this section.*

**Current Law/Practice:**

(Information being researched, but not available as of the hearing date)

**Analysis of Proposed Law/Practice:**

(Information being researched, but not available as of the hearing date)

**Action Taken (if any):**

Legislation has not been introduced for another earthquake safety bond bill. No 1996 ballot measure. Most of Prop 122 bond money has been committed with only a small amount remaining in reserve.

**(22) Recommendation #74:**

*The Essential Services Act (ESA) be amended to require buildings designated as community shelters and those buildings that serve as the place of business for local governments, such as city halls, be placed within the definition of "essential services buildings."*

**Current Law/Practice:**

(Information being researched, but not available as of the hearing date)

**Analysis of Proposed Law/Practice:**

(Information being researched, but not available as of the hearing date)

**Action Taken (if any):**

No one has introduced a bill. No action has been taken on this recommendation.



**(23) Recommendation #110:**

*Automatic gas shut-off valves be mandatory at the service entry point at all mobile home parks in California.*

**Current Law/Practice:**

(Information being researched, but not available as of the hearing date)

**Analysis of Proposed Law/Practice:**

Per HCD: This recommendation was introduced legislatively as SB 577 (Rosenthal). The gas utility companies are opposed due to the historic "nuisance tripping" of current technology earthquake activated gas shut-off valves that are unable to distinguish earthquake activities from other types of shock or ground motion. Nuisance tripping requires the relighting of pilot lights, etc., and could affect hundreds of park residents in instances not related to earthquakes. The gas utilities have been successful in having mobile home parks where residents are directly served by the gas utility exempted from the automatic gas shut-off valve requirement. This leaves mobilehome parks that are "master metered" (i.e., the park purchases the gas from the utility at the park boundary and resells the gas to park residents, subject to SB 577 requirements).

HCD believes that this recommendation has been implemented through introduction of SB 577 and no further action by the Administration is required.

**Action Taken (if any):**

The SSC Sponsored SB 577 (Rosenthal, 1995) which would have implemented this recommendation. Assembly amendments deleted that requirement and instead expanded the type of gas shut-off devices subject to the State Architect's standards. Governor Wilson signed the amended bill as Chapter 152, Statutes of 1996.

**(24) Recommendation #141:**

*Legislation be enacted to require CDMG to convene a high-level independent review board for the preparation and review of guidelines and maps prepared under the SHMA.*

**Current Law/Practice:**

Per Resources Agency: This recommendation is already being implemented under the auspices of the State Mining & Geology Board (SMGB).

**Analysis of Proposed Law/Practice:**

Per Resources Agency: The Geohazards Committee of the SMGB is composed of gubernatorial appointees who have primary advisory responsibility. Due to legislative changes in 1990, the Department established an advisory committee with expertise and experience specified in the SHMP to guide the SMGB, the State Geologist and CDMG on policies and procedures for implementing the Act. This committee, composed of leaders in their respective fields, has developed a number of working groups consisting of prominent scientists, engineers and public policy individuals. The working groups will address issues such as liquefaction, earthquake-induced landslides and amplified ground shaking hazards.

**Action Taken (if any):**

Per Resources Agency: The advisory committee and SMGB will continue to advise the State Geologist and CDMG on new technical approaches and effective implementation of the Seismic Hazards Mapping Act (SHMA). Neither the SMGB nor the Dept. Of Conservation sees any advantage to establishing advisory bodies for administration of the Act beyond those mentioned above. To do so would be to duplicate already existing activities.

**(25) Recommendation #147:**

*Legislation be enacted to allow designation of active fault zones based on all viable geologic, geodetic, and tectonic evidence and provide for alternative mitigation measures to be defined by the Mining and Geology Board as appropriate to complex areas where the location of potential fault ruptures is uncertain.*

**Current Law/Practice:**

(Information being researched, but not available as of the hearing date)

**Analysis of Proposed Law/Practice:**

CDMG believes this is a duplicate of SSI's recommendation #11. Recommendation #11 states:

*CDMG, as part of its SHMA program, and under the policies of the State Mining and Geology Board, expand the categories of the seismic hazards to create a new hazard zone to address ground deformation and amplified shaking associated with folding and faulting.*

Per CDMG: This specifies that the Division create a new hazard zone to identify potential surface deformation associated with blind or buried thrust faults. CDMG plans to explore this possibility. This item is a moderate priority that requires further study. If CDMG and the State Mining & Geology Board determine that it is feasible to establish such zones, the activity could require some additional funding.

**Action Taken (if any):**

The SSC sponsored SB 1720 (Alquist, 1996) which died in the Senate Toxics and Public Safety Management Committee.

No other action has been taken; however, CDMG plans to explore and study the possibility of creating a new hazard zone to identify potential surface deformation associated with blind or buried thrust faults.



**(26) Recommendation #155:**

*Legislation be enacted to amend the Alquist-Priolo Act and the SHMA so they apply to all facilities that produce or store reportable quantities of acutely hazardous materials.*

**Current Law/Practice:**

(Information being researched, but not available as of the hearing date)

**Analysis of Proposed Law/Practice:**

(Information being researched, but not available as of the hearing date)

**Action Taken (if any):**

The SSC sponsored SB 1720 (Alquist, 1996) which died in the Senate Toxics and Public Safety Management Committee.

**EARTHQUAKE REHABILITATION BOND FUND**  
**STATE OWNED BUILDINGS**  
**Division of the State Architect**  
**Appropriation Balance**

Dollars in Thousands

The purpose of this document is to provide a review of the balance of funds remaining from the total of \$250 million authorized by Proposition 122 for the seismic rehabilitation of State owned buildings. Revenues collected from the sale of bonds are deposited in this account to fund the reconstruction, seismic retrofitting, repair, and replacement of State government buildings which are unsafe primarily due to earthquake-related dangers. Administrative costs of the program are also paid from this fund.

	ACTUAL 1992/93	ACTUAL 1993/94	ACTUAL 1994/95	ACTUAL 1995/96	PROJECTED 1996/97
<b>BEGINNING BALANCE</b>	\$243,329	\$242,569	\$234,910	\$222,388	\$199,391
Prior Year Adjustments	0	0	0	0	0
<b>Adjusted Balance</b>	<b>\$243,329</b>	<b>\$242,569</b>	<b>\$234,910</b>	<b>\$222,388</b>	<b>\$199,391</b>
<b>EXPENDITURES</b>					
<i>Disbursements</i>					
Support Costs	321	397	434	505	461
Senate Bill 597	0	8	4	153	0
Seismic Safety Commission	439	914	175	566	578
<b>Total State Operations</b>	<b>\$760</b>	<b>\$1,319</b>	<b>\$613</b>	<b>\$1,224</b>	<b>\$1,039</b>
<i>Capital Outlay</i>					
Museum of Science & Industry	0	3,090	11,909	0	0
Dept of General Services	0	3,250	0	21,773	106,484
<b>Total Capital Outlay</b>	<b>\$0</b>	<b>\$6,340</b>	<b>\$11,909</b>	<b>\$21,773</b>	<b>\$106,484</b>
<b>Total Expenditures</b>	<b>760</b>	<b>7,659</b>	<b>12,522</b>	<b>22,997</b>	<b>107,523</b>
<b>ENDING BALANCE</b>	<b>\$242,569</b>	<b>\$234,910</b>	<b>\$222,388</b>	<b>\$199,391</b>	<b>\$91,868</b>

**DEFINITIONS:**

*Support Costs:* Actual expenses for staff support to the program.

*SB 597:* This Senate Bill authorized up to \$320,000 from this fund to be used to develop retrofit guidelines.

*Seismic Safety Commission:* Actual expenses for support of the program provided by the Commission.

*Museum of Science and Industry:* Actual capital outlay expenditures for the CMSI retrofit project.

*Department of General Services:* The actual cost of the projects to retrofit seismically deficient State buildings.

**EARTHQUAKE SAFETY AND PUBLIC BUILDING  
REHABILITATION BOND ACT**

<i>State-Owned Building Program:</i>	<b>\$250,000</b>	<i>Local Government Grant Program:</i>	<b>\$50,000</b>
SMIF Interest Earned	\$736		
<b>Sub-total Available Funds:</b>	<b>\$250,736</b>	<b>Sub-total Available Funds:</b>	<b>\$50,000</b>
Expended through 6/30/96	\$45,586	Grants Allocated	\$42,392
1996/97 Budget Act	\$106,484		
Support - Expenses through 6/30/96	\$5,758	Support - Expenses through 6/30/96	\$2,035
Support - 1996/97	\$1,039	Support - 1996/97	\$287
<b>Balance</b>	<b><u>\$91,869</u></b>	<b>Balance</b>	<b><u>\$5,286</u></b>

Dollars shown in thousands (000)



**EARTHQUAKE REHABILITATION BOND FUND  
STATE OWNED BUILDINGS**

(Dollars in Thousands)

**LISTING OF STATE OWNED BUILDING PROJECTS:**

	YTD Actual	1996/97 Budget Act
California Youth Authority - Amador Kitchen	\$91	\$1,956
Norco Admin Building 101	\$581	\$50
California Museum of Science and Industry	\$16,410	
Department of Corrections - Educational G Vocational, Tehachapi		\$57
Department of Corrections - J Kitchen Laundry, Tehachapi		\$49
Department of Corrections - San Quentin	\$88	\$3,752
Department of Corrections - Represa Dining Room 1		\$1,576
Department of Corrections - Represa Dining Room 2	\$83	\$1,865
Department of Corrections - Represa 1 Inmate Housing	\$382	\$6,790
Department of Corrections - Represa 5 Inmate Housing	\$133	\$3,599
Department of Corrections - South Block, San Quentin		\$511
Department of Corrections - West Block, San Quentin		\$310
Department of Developmental Services - B One Main Kitchen, Pomona		\$274
Department of Education - Building P-1, Riverside		\$55
Department of Food and Agriculture - Annex Building		\$252
Department of General Services - Elihu Harris Building	\$1,250	
Department of General Services - Sac Legislative Office Building	\$1,621	\$1,451
Department of General Services - LA Junipero Serra Office Building	\$9,118	\$0
Department of General Services - LA Second Street Parking Garage	\$2,900	\$0
Department of General Services - Sacramento Resources Building	\$2,016	\$30,160
Department of General Services - Sacramento Library & Courts Bldg	\$1,422	\$21,928
Department of General Services - Sacramento Jesse Unruh Building	\$840	\$20,377
Department of General Services - San Francisco State Office Complex	\$6,153	
Department of General Services - Santa Ana Office Building		\$601
Department of Mental Health - B Ward, Napa		\$362
Department of Mental Health - Norwalk CT West A-E	\$208	\$1,496
Department of Mental Health - Norwalk CT East A-E	\$187	\$1,488
Department of Mental Health - Norwalk Receiving & Treatment Bldg 1	\$124	\$766
Department of the Military -Santa Barbara Armory		\$624
Department of Parks and Recreation - Petaluma Adobe SHP		\$252
Department of Veterans Affairs - Yountville Hospital Admin Services	\$551	\$4,694
Department of Veterans Affairs	\$3	
Employment Development Department		\$496
Building Risk Assessments	\$750	\$0
Program Management	\$675	\$693
<b>TOTAL STATE-OWNED BUILDINGS</b>	<b>\$45,586</b>	<b>\$106,484</b>

## EARTHQUAKE REHABILITATION BOND FUND LOCAL GOVERNMENT GRANTS

### *LISTING OF LOCAL GOVERNMENT GRANT PROJECTS:*

Project Number	Description	Total Allocated
SP.S3	San Carlos Fire Station	\$153,807
SP.S3.005	Union City Decoto Fire Station	\$49,670
SP.S3.006	Galt Fire Station #44	\$556,800
SP.S3.011	Redwood City Old Courthouse	\$2,121,750
SP.S3.014	Kenwood Fire Station	\$44,853
SP.S3.015	Kettleman City Center	\$387,525
SP.S3.018	Santa Cruz Live Oak Station	\$101,019
SP.S3.019	Capitola	\$42,410
SP.S3.021	Chalfant Fire Station	\$57,195
SP.S3.029	San Luis Obispo Fire Station	\$610,998
SP.S3.031	San Luis Obispo Government Center	\$500,000
SP.S3.033	Hayward Highlant Reservoir Emergency Generator	\$567,000
SP.S3.034	Hayward Hat Tower Generator	\$79,190
SP.S3.035	Hayward Portable Emergency Generator	\$72,750
SP.S3.036	Hayward EOC and Corp Yard Emergency Generators	\$533,250
SP.S3.048	Santa Ana Orange County Central Courthouse	\$1,682,340
SP.S3.050	San Diego Fire Station #11	\$571,809
SP.S3.055	Mill Valley City Hall & Fire Station	\$304,082
SP.S3.069	San Diego County EOC/Community Center	\$326,700
SP.S3.070	Monterey Colton Hall	\$142,875
SP.S3.071	Pismo Beach Communication Center/City Hall	\$768,822
SP.S3.072	Pismo Beach Fire Station #1	\$1,725
SP.S3.073	Auburn OES Building 7	\$202,492
SP.S3.075	Hayward Fairview Fire Generator	\$21,375
SP.S3.076	Ventura Fire Station #2	\$96,875
SP.S3.078	San Marino Fire Station	\$300,422
SP.S3.080	San Leandro City Hall	\$892,105
SP.S3.081	San Leandro Fire Station #5	\$117,122
SP.S3.082	San Leandro Public Safety Building	\$263,105
SP.S3.085	San Leandro Fire Station #1	\$53,109
SP.S3.086	San Leandro Fire Station #4	\$106,227
SP.S3.088	Big Bear Lake Headquarters Fire Station	\$280,160
SP.S3.089	Big Bear Lake Emergency Power Generator	\$58,271
SP.S3.090	Fort Bragg Police Station	\$626,035
SP.S3.101	Coalinga Pleasant Valley Fire Station	\$480,683
SP.S3.108	Bakersfield Fire Station #2	\$309,000
SP.S3.116	Richmond City Hall	\$1,149,975
SP.S3.117	Richmond Hall of Justice	\$1,183,613
SP.S3.120	San Francisco Central Fire Alarm Station	\$444,239
SP.S3.122	San Francisco Fire Station #41	\$545,994
SP.S3.124	San Francisco Fire Station #36	\$519,704
SP.S3.126	San Francisco Fire Station #34	\$819,726
SP.S3.127	San Francisco Fire Station #18	\$1,311,220
SP.S3.133	San Bruno Women's Jail #3	\$839,728

Project Number	Description	Total Allocated
SP.S3.134	Cotati Veteran's Building	\$8,346
SP.S3.135	Occidental Community Center	\$33,787
SP.S3.136	Guerneville Substation/Veterans Building	\$62,534
SP.S3.137	Cloverdale Veterans Building	\$80,609
SP.S3.138	Petaluma Veterans Building	\$52,500
SP.S3.139	Sebastopol Veterans Building	\$63,450
SP.S3.140	Sacramento Electrical Vault Building	\$35,074
SP.S3.141	Sacramento Fire/Crash Building	\$147,579
SP.S3.147	Sacramento Juvenile Hall	\$392,118
SP.S3.151	Milipitas Fire Station #1	\$148,110
SP.S3.152	Milipitas Fire Station #2	\$144,624
SP.S3.153	Milipitas Fire Station #3	\$144,624
SP.S3.156	Berkeley Fire Station #2	\$352,189
SP.S3.157	Berkeley Fire Station #5	\$183,403
SP.S3.158	Berkeley Fire Station #6	\$45,705
SP.S3.159	Berkeley Fire Station #4	\$53,950
SP.S3.160	Berkeley Fire Station #3	\$109,361
SP.S3.161	Berkeley Fire Station #1	\$46,931
SP.S3.162	Berkeley Fire Station #7	\$50,294
SP.S3.163	Berkeley Hall of Justice	\$3,200,068
SP.S3.164	Berkeley Equipment Maintenance Building	\$216,865
SP.S3.165	Berkeley Facilities Maintenance Building	\$401,292
SP.S3.166	Berkeley Martin Luther King, Jr Civic Center	\$500,000
SP.S3.167	Vacaville Fire Station #1	\$330,657
SP.S3.168	Big Bear Lake City Hall	\$187,500
SP.S3.170	Hollister EOC	\$93,500
SP.S3.175	Sonoma Schell-Viusta Fire Station	\$479,029
SP.S3.179	Fillmore Girls Gymnasium	\$265,844
SP.S3.185	Fillmore Fire Stations	\$59,625
SP.S3.190	Eureka City Hall	\$181,361
SP.S3.191	Alameda City Hall	\$2,280,857
SP.S3.193	Berkeley Fire Department Headquarters	\$156,817
SP.S3.196	Lake Arrowhead Fire Station #19	\$373,178
SP.S3.241	Hayward Fire Station #1	\$1,084,750
SP.S3.242	San Fernando Emergency Communication Center	\$192,016
SP.S3.245	Glendora City Hall	\$89,056
SP.S3.255	Csoronado Fire Station Headquarters/EOC	\$218,762
SP.S3.273	El Cerrito Fire Station #2	\$93,332
SP.S3.284	Rodeo Fire Station	\$393,802
SP.S3.285	Eureka Municipal Auditorium/Emergency Shelter	\$94,887
SP.S3.289	Salinas Emergency Power Generator	\$14,121
SP.S3.292	Torrance Harbor/UCLA Medical Center	\$9,032,007
	<b>TOTAL</b>	<b>\$42,392,264</b>



GOVERNOR PETE WILSON

SEP 30 1996

To the Members of the California Senate:

I am returning Senate Bill No. 1490 without my signature.

This bill would require guidelines for the application of seismic technologies in the California Building Standards Code, and would obligate building design professionals in the private sector to disseminate a specified statement describing the Code's seismic standards.

Existing seismic safety standards in state law require compliance for the protection of the public. The disclosure statement required by this bill is an implied argument that the owner should seek a still higher standard to protect his real property so that it "will remain functional during and after a major seismic event". While this is a laudable goal, it is one that applies to all projects for which an architect, civil engineer, or structural engineer, is employed. There are a great many circumstances in California where such a disclosure statement would be completely unnecessary. As such, it simply makes no sense to impose this requirement on every design, development, construction, retrofitting, repair, or renovation project which involves these professions.

Cordially,



PETE WILSON

# Seismic Hazard Mapping Bulletin #1

Department of Conservation  
Division of Mines and Geology  
801 K Street, MS 12-31  
Sacramento, CA 95814



## Seismic Hazard Zone Maps Released

**T**he State Department of Conservation's Division of Mines and Geology has released six preliminary Seismic Hazard Zone Maps, the first in a series. Five of the maps were prepared with funding from the Federal Emergency Management Agency and the Governor's Office of Emergency Services. Thirty-three more maps will be completed for portions of Ventura, Los Angeles and Orange counties over the next two years.

On October 8, 1996, the six preliminary maps were distributed to all California cities and counties and to affected state and federal agencies, beginning a 90-day review and comment period. At the same time the State Mining and Geology Board released draft implementation guidelines for a 90-day review.

The Legislature passed the Seismic Hazard Mapping Act in 1990 (AB 3897; Public Resources Code, Chapter 7.8, Sections 2690-2699.6), directing the Division of Mines and Geology to prepare the maps. The purpose of the Act is to reduce threat to public health and safety and to minimize economic loss due to seismic hazards.

The Act directs cities, counties and state agencies to use the maps in their land use planning and permitting processes. A site-specific geotechnical report is required prior to permitting most urban developments within the zones. The Act also requires sellers of real property (or their

agents) within the zones to disclose this fact to potential buyers.

The guidelines will aid local agencies in establishing land use management policies and ordinances to reduce and mitigate losses from

ground failure during earthquakes. The maps and guidelines may also be useful to insurance companies, consultants, investors and the public. A twelve-member advisory committee

*Continued on page 4*





# Seismic Hazard Zone Maps Represent State-of-the-Art Technology

**T**he California Department of Conservation's Division of Mines and Geology, is working with state-of-the-art technology, identifying and mapping the state's most prominent earthquake hazards. The Department's geologists will ultimately chart areas prone to liquefaction (failure of water-saturated soil) and earthquake-induced landslides throughout the state's principal urban and major growth areas (see figure opposite).

The official maps produced by the Seismic Hazard Mapping Program are mandated by the Seismic Hazard Mapping Act of 1990 to be used by cities and counties to regulate development within identified seismic hazards. Local governments, at their discretion, can withhold development permits until geologic or soils investigations are conducted and mitigation measures are incorporated into project plans.

## UNIQUE ASPECTS

Previously, seismic hazard maps may have been done by local governments or other parties in selected areas or for special purposes. The official Seismic Hazard Zone Maps are different in three key aspects:

- ◆ First, the Division scientists integrate the very latest geotechnical data available with state-of-the-art computer technology to produce the maps. The information is the most up-to-date possible at the time of production.
- ◆ The Department uses a standardized method of hazard assessment to evaluate hazard potential consistently for the entire state. Other mappers have applied their own

criteria for assessing hazards in the smaller study areas. Viewed together, these maps would show a patchwork-quilt view of the region as a whole. It is this standardized look at the hazards that make these official maps particularly valuable.

- ◆ These are the first seismic hazard maps to use a scale (1:24,000) large enough to provide a detailed look at a large region. Based on existing U.S. Geological Survey topographic quadrangle maps, each map covers an area approximately 60 square miles in size. Most currently available maps are at a much smaller scale of 1:100,000.

## PRODUCTION PROCESS

The maps are the result of detailed data analyses by the Division's geologists and seismologists. The experts examine the latest information about surface and subsurface geology, historic groundwater levels and damage and geologic effects resulting from the Northridge and other earthquakes throughout California. With a state-of-the-art seismic hazard mapping system, the data are integrated into a three-dimensional view of the ground.

Capabilities of the seismic hazard mapping system include, but extend beyond those of a conventional geographic information system. In addition to having the capability to store and manipulate large volumes of spatial data, the system permits subsurface geological analysis, photogrammetry and remote sensing analysis, including stereoscopic display of aerial images of the land for interactive analysis of the surface geology and topography of the landscape.

Division geoscientists in Sacramento, Los Angeles, and San Francisco are linked by a high-speed wide-area network with all the essential analysis tools for seismic hazard zone delineation at the desktop. Time required for complex tasks, such as mapping of existing land-slides over large areas, have been reduced from months to weeks using this system.

Seismic hazard zone map information will be made available in several formats, including the Spatial Data Transfer Standard (FIPS 173), for use on a local geographic information system.

## FUNDING

The Seismic Hazard Mapping Program was originally funded by the California Residential Earthquake Recovery Fund and a portion of local building permit fees. In the early 90s, however, funding for the program was greatly reduced when the recession slowed construction and the Earthquake Recovery Fund was cancelled.

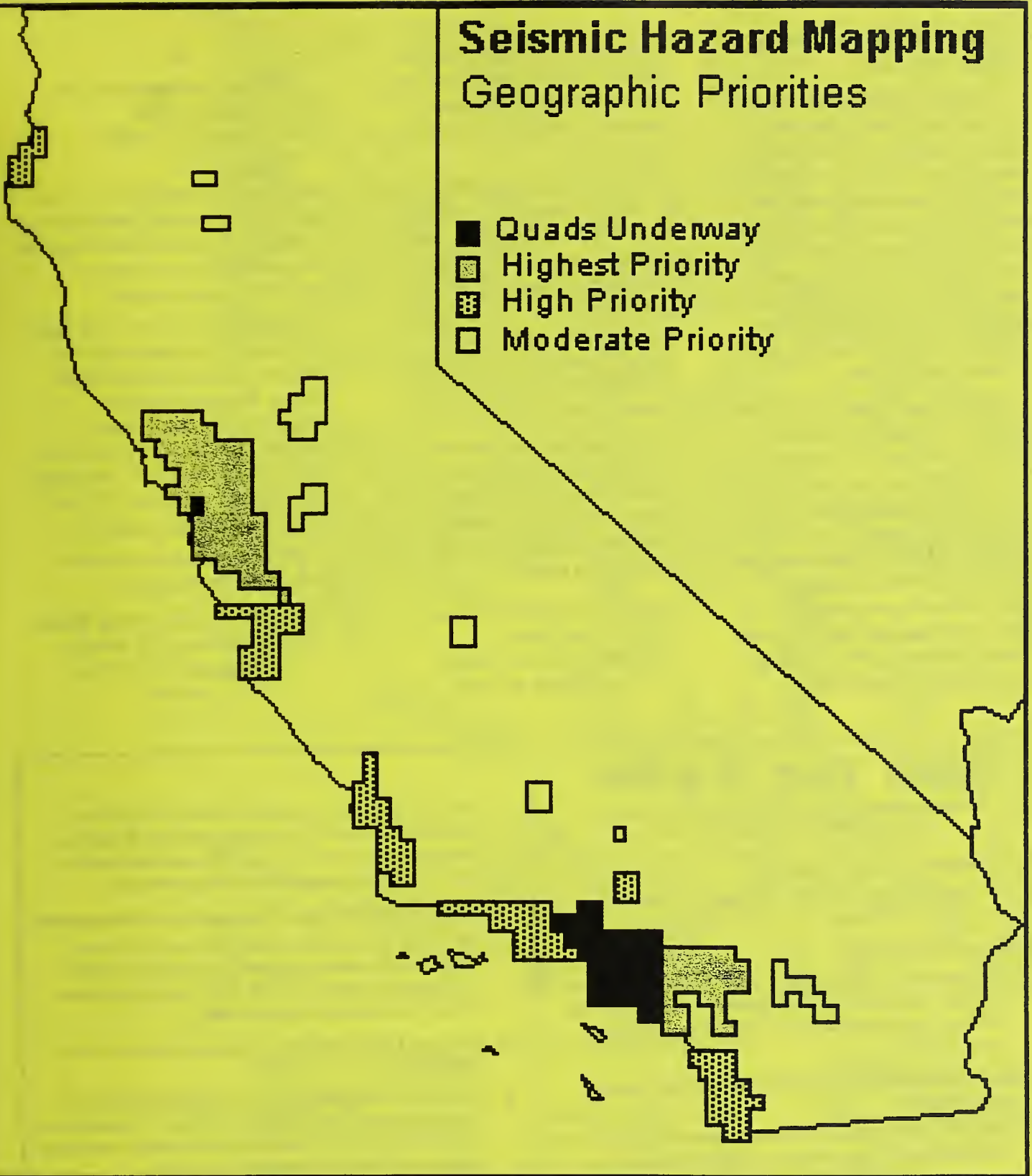
The Department of Conservation was able to continue the program with federal disaster relief funds from the Federal Emergency Management Agency, through the Governor's Office of Emergency Services. As much as \$15 million has been earmarked for seismic hazard mapping in Southern California counties affected by the 1994 Northridge earthquake.





# Seismic Hazard Mapping Geographic Priorities

- Quads Underway
- ▒ Highest Priority
- ▓ High Priority
- Moderate Priority



Maps to be released over the next two years are shown in black. The current release includes San Francisco North and the Treasure Island portion of Oakland West, Topanga, Simi Valley East, Simi Valley West, Anaheim, and Newport Beach quadrangles. Maps scheduled for release in 1997 and 1998 are shown on front cover. Remaining areas shown identify possible future work, pending on availability of funding.

assisted the Board in developing the draft guidelines.

The maps identify areas where soil liquefaction and earthquake-induced landslides are most likely to occur. The Liquefaction Hazard Zones are areas underlain by saturated sands and silts deposited during the last 10,000 years. The Landslide Hazard Zones are areas, generally steep hillslopes composed of weak materials, where earthquakes are likely to trigger landslides, rockfalls, and other slope failures.

The proposed hazard zones were delineated by highly-skilled staff using state-of-the-art computer technology to compile geologic data from local government agency files and other appropriate sources. The data include basic geologic mapping by state and federal geologists, historic records, and topographic data. Interpretation of the data leads to identification of areas known to have experienced landslides or

liquefaction during historic (last 250 years) earthquakes, or where conditions indicate that these hazards are likely to occur in the future.

Following the review period, the maps and guidelines will be revised in response to comments received. The State Mining and Geology Board plans to adopt the guidelines no later than March 1 unless revisions are extensive. About the same time, the State Geologist will issue official versions of the first six maps.

The deadline for submitting comments on both the maps and guidelines is January 7, 1997. Copies of the maps are available as blue-line prints for the cost of reproduction from:

BPS Reprographic Services  
149 Second Street  
San Francisco, CA 94103  
(415) 495-8700 ext. 550

or

Universal Reprographics, Inc.  
2076 Wilshire Blvd.  
Los Angeles, CA 90057  
(213) 365-7773

Reduced-size versions of the maps and copies of the draft guidelines are available through the Department of Conservation's home page at: <http://www.consrv.ca.gov/>.

To purchase copies of the draft guidelines or for assistance with map and guideline interpretation, contact the Department of Conservation at one of these locations: Los Angeles (213) 620-3560; Sacramento (916) 445-5716; San Francisco (415) 904-7707; or email: [tsmith@consrv.ca.gov](mailto:tsmith@consrv.ca.gov).

Please send comments on the maps and/or guidelines to:

State Mining and Geology Board  
801 K Street, MS 24-05  
Sacramento, CA 95814



## Just the FAQs

*Frequently Asked Questions about earthquake hazards and the Seismic Hazard Mapping Act*

**Q. What hazards do the maps show?**

*A. The maps show areas that have potential for landslide and liquefaction hazards.*

**Q. What is liquefaction?**

*A. During an earthquake saturated sandy and silty soils may "liquefy." The soils "fail" to support buildings, which can sustain severe damage unless the hazard is recognized and mitigated.*

**Q. How are these maps different from the maps released last February?**

*A. Although these maps partly cover the same areas as the "reconnaissance" maps released in early February, they are based on additional data thus they are much more detailed and accurate than the earlier maps.*

**Q. What are the responsibilities of the cities and counties? Are they required to enact an ordinance?**

*A. The Act leaves the implementation procedures to the discretion of local governments. The State Mining*

*and Geology Board has drafted guidelines to assist in local implementation. Some cities may want to enact an ordinance; others may rely on CEQA and the planning process, or their own permit review procedures.*

**Q. Does the Seismic Hazard Act apply to all development?**

*A. No. The Act is directed at mitigating hazards to new structures for human occupancy, though some smaller developments may be exempt. Cities and counties may have more restrictive requirements.*

**Q. How can I find out about earthquake hazards on my property?**

*A. Copies of the maps can be purchased from BPS Reprographic Services and Universal Graphics. The addresses are provided above. Many cities and counties may make copies available for viewing in their offices.*

**Q. When the next earthquake occurs will the entire area shown on the maps be devastated?**

*A. The maps show areas that are prone to landslides and liquefaction. This does not mean that the area will be uniformly affected during an earthquake, nor that areas outside the zone will be unaffected.*



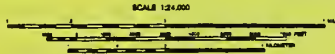


FOR REVIEW PURPOSES ONLY  
 This map will be superseded  
 by Official Map on March 1, 1997

Base Map created by U.S. Geological Survey 1951, photorevised 1989  
 CALIFORNIA  
 DATE: December 10, 1988

**IMPORTANT - PLEASE NOTE**

- 1) This map may not show all areas that have the potential for liquefaction (landsliding along earthquake ground shaking or other earthquake and geologic hazard) and is a general indication of relative hazard. Occurrence of triggering and/or failure will not uniformly affect the entire area zoned.
- 2) Liquefaction Hazard Zones may also contain areas susceptible to the effects of earthquake-induced landslides. The situation typically occurs at or near the toe of existing landslides downslope from vertical or oblique flow source areas, or adjacent to steep stream banks.
- 3) This map does not show Active-Fault Earthquake Fault Zones, if any that may exist in the area. Please refer to the latest Official Map of Earthquake Fault Zones for boundaries and other actions that are required by the Active-Fault Earthquake Fault Zoning Act.
- 4) Landslide hazard areas created by the U.S. Geological Survey (USGS) and their information should not be used as a substitute for those Official Earthquake-Induced Landslide Hazard Zones. Although similar data were used in the development of both maps, the U.S. Geological Survey maps are based on a more detailed approach designed to explore new methods to assess earthquake-induced landslide hazards.
- 5) The identification and location of liquefaction and earthquake-induced landslide hazard areas are based on available data. However, the quality of data used is varied. The information depicted has been drawn as accurately as possible on the map scale.
- 6) Information on the map is not sufficient to serve as a substitute for the geologic and geotechnical site investigations required under Chapters 7.5 and 7.8 of Division 2 of the California Public Resources Code.
- 7) **DISCLAIMER:** The State of California and the Department of Conservation make no representations or warranties regarding the accuracy of the data from which these maps were derived, neither the State nor the Department shall be liable under any circumstances for any direct, indirect, special, incidental, or consequential damages with respect to any claim by any user or any third party on account of or arising from the use of this map.



**STATE OF CALIFORNIA  
 SEISMIC HAZARD ZONES**

Developed in accordance with  
 Chapter 7.5, Division 2 of the California Public Resources Code  
 (Seismic Hazard Mapping Act)

**SIMI VALLEY EAST QUADRANGLE**

**PRELIMINARY REVIEW MAP**

Released: October 1, 1996

SEND TECHNICAL COMMENTS TO:  
 State Mining and Geology Board  
 501 N. Street, 10th Floor  
 Sacramento, CA 95814  
 COMMENT DEADLINE: December 31, 1996

**MAP EXPLANATION**

**Liquefaction Hazard Zones**

Areas where historic occurrence of liquefaction of loose geological, geotechnical and ground water conditions indicates a potential for permanent ground displacements such that mitigation as defined in Public Resources Code Section 25803(c) would be required.

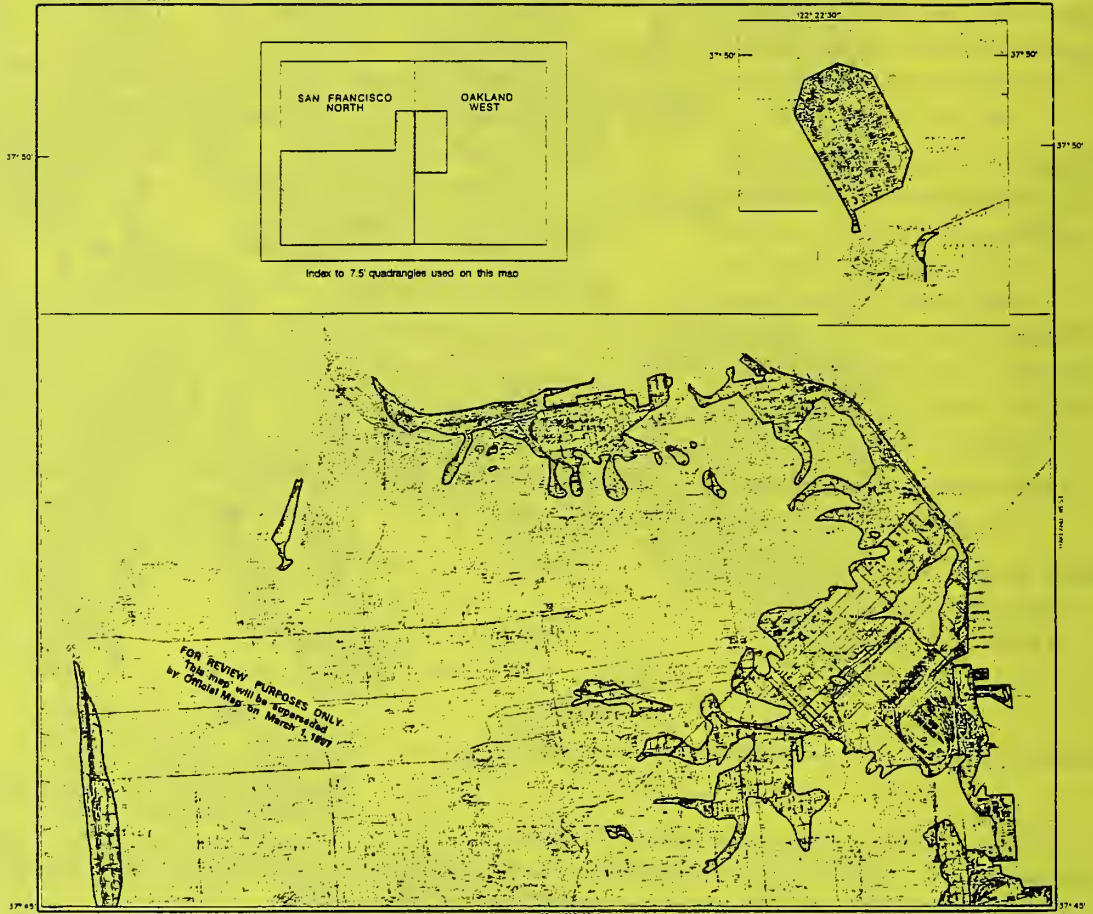
**Earthquake-Induced Landslide Hazard Zones**

Areas where a historic occurrence of landslide movement or local slope failure indicates a potential for permanent ground displacements such that mitigation as defined in Public Resources Code Section 25803(c) would be required.

**REFERENCES USED TO COMPILE THIS MAP**

- California Department of Conservation, Division of Mines and Geology, 1988. Liquefaction Hazards in the Simi Valley East and San Gabriel Basins. Technical Report 158. Irvine and Ventura Counties, California. California Department of Conservation, Division of Mines and Geology, Liquefaction Hazards in the Simi Valley East and San Gabriel Basins. Technical Report 158. Irvine and Ventura Counties, California. California Department of Conservation, Division of Mines and Geology, Earthquake-Induced Landslide Hazards in the Simi Valley East and San Gabriel Basins. Technical Report 159. Irvine and Ventura Counties, California. California Department of Conservation, Division of Mines and Geology, Earthquake-Induced Landslide Hazards in the Simi Valley East and San Gabriel Basins. Technical Report 159. Irvine and Ventura Counties, California.





Base Map prepared by U.S. Geological Survey, San Francisco North 1958, photorevised 1968 and 1973, Oakland West 1958 photorevised 1962

SCALE 1:50,000

DATE September 1988

**IMPORTANT - PLEASE NOTE**

- 1) This map may not show all areas that have the potential for liquefaction resulting from earthquake ground shaking or other earthquake and geologic hazards. Also a single earthquake capable of causing foundation or piping failures will not uniformly affect the entire area shown.
- 2) Liquefaction Hazard Zones may exist in areas susceptible to the effects of earthquake-induced landslides. This situation typically arises at or near the toe of existing landslides down-slope from "normal" or older flow source areas, or adjacent to areas shown herein.
- 3) This map does not show Active-Fault Earthquake Fault Zones, if any, that may exist in the area. Please refer to the latest Official Map of Earthquake Fault Zones for descriptions and other actions that are required by the Active-Fault Earthquake Fault Zoning Act.
- 4) Landslide hazard maps prepared by the U.S. Geological Survey, Lisbon and "new" in preparation should not be used as a substitute for State Official Earthquake-Induced Landslide Hazard Zones. Although similar data were used in the development of both maps, the U.S. Geological Survey maps are based on an assessment approach designed to address new methods to assess earthquake-induced landslide hazards.
- 5) The identification and location of liquefaction and earthquake-induced landslide hazard areas are based on available data. However, the quality of data used is varied. The information depicted has been drawn as accurately as possible at this map scale.
- 6) Information on this map is not sufficient to serve as a substitute for the geologic and geotechnical site investigations required under Chapters 7.5 and 7.6 of Division 2 of the California Public Resources Code.
- 7) DISCLAIMER: The State of California and the Department of Conservation make no representations or warranties regarding the accuracy of the data from which these hazard areas derived. Neither the State nor the Department shall be liable under any circumstances for any direct, indirect, special, incidental or consequential damages, with respect to any claim, by any user or any third party on account of or arising from, the use of this map.

**STATE OF CALIFORNIA  
SEISMIC HAZARD ZONES**

Developed by the California Department of Conservation  
Chapter 7.5, Division 2 of the California Public Resources Code  
Division 2, Section 26000

**SOUTH HALF OF THE SAN FRANCISCO NORTH  
AND PART OF THE OAKLAND WEST QUADRANGLES**

**PRELIMINARY REVIEW MAP**

Released: October 1, 1996

SDG TECHNICAL COMMITTEE  
Dale Hering and George Beard  
201 N. Street, Los Angeles  
California, CA 90012  
COMMITTEE CHAIRMAN: December 20, 1988

**MAP EXPLANATION**

**Liquefaction Hazard Zones**

Areas where historic occurrence of liquefaction or soil geologic, geotechnical and ground water conditions indicate a potential for permanent ground displacements such that mitigation as defined in Public Resources Code Section 26000 should be required.

**IMPORTANT - PLEASE NOTE:** Earthquake-induced Landslide Hazard Zones are not depicted on this map. Although such hazards are known to exist in the area, they have not yet been evaluated.

**REFERENCES USED TO COMPILE THIS MAP**

South Half of the San Francisco North and Part of the Oakland West Quadrangles  
1:50,000 Scale  
U.S. Geological Survey, San Francisco North 1958, photorevised 1968 and 1973, Oakland West 1958 photorevised 1962  
California Department of Conservation, Division 2, Section 26000  
The following information is intended to provide information on the map scale to address the need of users and determine whether the information is sufficient for their purposes. It is not intended to be a substitute for the information required by the California Public Resources Code, Division 2, Section 26000.

# **“SHAKEN AWAKE!”**

## **THE PROBLEM OF UNINHABITABLE DWELLINGS**

COMMENTS PRESENTED BY JEANNE PERKINS  
EARTHQUAKE PROGRAM MANAGER  
ASSOCIATION OF BAY AREA GOVERNMENTS

AT THE OCTOBER 16, 1996 HEARING OF  
THE CALIFORNIA STATE SENATE HOUSING AND LAND USE COMMITTEE

### **AN OUNCE OF PREVENTION: PLANNING & REGULATING FOR SEISMIC HAZARDS**

*The San Francisco Bay Area is in “earthquake country.”* Many moderate to great earthquakes (over magnitude 6.0) have affected the Bay Area; 22 such events have occurred in the last 160 years – for an average of one every seven years. At least 10 faults have the capability of generating magnitude 7 or greater earthquakes in the next 30 years. USGS has developed probability estimates for four of those events of roughly 1 in 4 for that period – the southern Hayward, the northern Hayward, the Healdsburg-Rodgers Creek and the peninsula segment of the San Andreas. In addition, the probability of the entire Hayward rupturing at once is roughly one in four of each of the two Hayward segments, or roughly 5-6% in the next 30 years.

*We can predict how hard the ground will shake in these future earthquakes.* ABAG has worked to take information on how ground shaking varies with distance to the fault sources and with geologic materials (such as hard granitic rock or soft Bay mud) to create maps of shaking intensity for each of these future earthquakes.

*Recent California earthquakes have had a devastating impact on housing.* The Loma Prieta earthquake produced a total of over 16,000 uninhabitable housing units throughout the Monterey and San Francisco Bay areas (including almost 13,000 in the Bay Area). In the 1994 Northridge earthquake, over 48,000 units were made uninhabitable.

In order to model the effects on housing from future earthquakes, data on habitability of housing structures after these two earthquakes was collected through a combination of telephone and in-person interviews with city and county building departments following the 1989 Loma Prieta earthquake and the 1994 Northridge earthquake. The residential structures tagged by local government building officials as unsafe (red) or limited access (yellow) following those earthquakes have been carefully examined and analyzed. The ratios between green-, yellow-, and red-tagged housing units for different types of housing construction obtained from that data were incorporated into the model. Extreme care was made to collect data on housing structure location, as well as age, type of construction, and number of units associated with those structures. *These statistics on damage in past earthquakes were then tied to ground shaking modeling to predict the numbers of uninhabitable units in future Bay Area earthquakes.*



*Uninhabitable* is defined as unable to be occupied due to structural problems. It is equivalent of the Applied Technology Council (ATC) "red" tagging for unsafe buildings where entry is prohibited for single family homes. For multi-family units, the structure can be either "red" tagged or "yellow" tagged where entry is restricted. Building departments in California uniformly use the ATC definitions in their post-earthquake tagging. *Uninhabitable dwellings are not necessarily destroyed; in fact, most are repairable.*

TABLE 1. PERCENT OF DWELLING UNITS UNINHABITABLE

TYPE	INTENSITY					
	V	VI	VII	VIII	IX	X+
Mobile Homes	0	0	0.87	40	90	100
Unreinforced Masonry	0	3.4	9.1	54	100	100
Non-Wood , 4-7 Stories, <1940	0.30	8.0	45	70	100	100
Non-Wood, 4-7 Stories, >1939	0	0	0	54	70	86
Non-Wood, 7+ Stories, <1940	0.30	8.0	45	70	100	100
Non-Wood, 7+ Stories, >1939	0	0	4	54	70	86
Wood-Frame, 4-7 Stories, <1940, Multi-Family	0	3.1	12	70	80	90
Wood-Frame, 4-7 Stories, >1939, Multi-Family	0	0.05	2.7	27	40	50
Wood-Frame, 1-3 Stories, <1940, Multi-Family	0	0.2	1.5	18	64	84
Wood-Frame, 1-3 Stories, >1939, Multi-Family	0.01	0.03	0.14	18	28	47
Wood-Frame, 1-3 Stories, <1940, Single Family (not retrofitted)	0.01	0.04	0.12	1.8	8.4	12
Wood-Frame, 1-3 Stories, >1939, Single Family (or <1940 retrofitted)	0	0	0.02	0.18	0.69	1.8
"Other" (tents, caves, boats, etc.)	0	0	0	0	0	0

*Note that the difference between pre- and post-1940 single family (or, similarly, between pre-1940 unretrofitted and pre-1940 retrofitted) is roughly a factor of 10. Thus retrofitting improves habitability by 90%!*



Six future Bay Area earthquakes are expected to have more of an impact on housing than the Loma Prieta earthquake. Three of these earthquakes will probably have a greater impact than the Northridge event:

- the entire Hayward (Magnitude 7.3; probability 5-6% in next 30 years)
- the southern Hayward (Magnitude 7.0; probability 23% in next 30 years)
- the northern Hayward (Magnitude 7.1; probability of 28% in next 30 years)

These are not unlikely earthquakes and the impacts are chilling, as shown in the following table.

**TABLE 2. UNINHABITABLE UNITS FOR BAY AREA COUNTIES AND SELECTED EARTHQUAKE SCENARIOS**

County Data for Earthquake Scenarios	Alameda	Contra Costa	Marin	Napa	San Francisco	San Mateo	Santa Clara	Solano	Sonoma	TOTAL
Loma Prieta - Actual	3284	0	2	0	9202	76	408	0	0	12,972
Loma Prieta - Modeled	1968	159	297	1	11781	223	1239	2	3	15,673
Hayward Combined	82563	9623	2128	34	38739	1638	13443	1028	892	150,087
Southern Hayward	52200	1070	1040	7	11630	241	9963	127	30	76,309
Northern Hayward	61901	7552	2007	22	15264	237	360	333	156	87,831
Healdsburg Rodgers Creek	3256	618	1222	46	11101	71	70	139	13669	30,192
Maacama	325	17	27	22	1986	11	11	15	798	3,212
Peninsula Segment of San Andreas	3139	46	800	2	19233	13166	9336	10	4	45,735
San Gregorio	1976	28	808	2	11650	1317	324	10	6	16,119
Northern Calaveras	6231	4114	27	15	2354	58	2490	134	5	15,428
Concord- Green Valley	3546	12195	28	1173	3191	74	324	2865	35	23,431
Greenville	2413	1734	27	14	576	16	120	324	5	5,230
West Napa	1382	284	27	4129	2011	15	29	1650	126	9,652

The impact of multi-family housing on these values is stressed in the following table. The failure of “soft-story” wood-frame apartment units (that is, with tucked under or first-floor parking) was responsible for over 6,000 of the 16,000 housing units rendered uninhabitable by the Loma Prieta earthquake and over 11,000 of the 48,000 housing units rendered uninhabitable by the Northridge earthquake. More importantly, these units would account for 100,000 of the expected 150,000 housing units rendered uninhabitable following a 7.3 earthquake on the Hayward fault.

**TABLE 3. UNINHABITABLE UNITS BY RESIDENTIAL CONSTRUCTION TYPE FOR SELECTED EARTHQUAKE SCENARIOS**

Construction Type Data for Earthquake Scenarios	Mobile Homes	Unreinforced Masonry	Non-Wood 4-7 Stories <1940	Non-Wood 4-7 Stories >1939	Non-Wood 7+ Stories <1940	Non-Wood 7+ Stories >1939	Wood 4-7 Stories <1940	Wood 4-7 Stories >1939	Wood 1-3 Stories <1940 Multi-Family	Wood 1-3 Stories >1939 Multi-Family	Wood 1-3 Stories <1940 Single Family	Wood 1-3 Stories >1939 Single Family
Loma Prieta - Actual	101	1936	1981	0	1230	664	3783	667	2018	216	301	75
Loma Prieta - Modeled	232	2159	1778	158	1491	1822	2819	1108	2278	1583	161	84
Hayward Combined	10892	13135	3053	1810	2580	8194	9419	9569	34234	49782	5273	2147
Southern Hayward	7793	3852	2009	368	1633	3783	3096	4962	12920	32405	2070	1417
Northern Hayward	3615	7187	2171	707	1740	4741	3838	7398	26274	24735	4443	983
Healdsburg Rodgers Creek	6697	2204	1739	216	1462	1994	2672	1172	3232	7937	465	404
Maacama	475	703	311	0	262	103	630	83	301	245	74	27
Peninsula Segment of San Andreas	1659	2490	1901	1549	1494	3220	5283	4905	6303	15909	605	416
San Gregorio	328	2107	1791	152	1465	1658	2817	1270	2230	2061	168	75
Northern Calaveras	1688	1159	608	12	454	445	743	1228	1108	7296	166	521
Concord-Green Valley	3660	1220	735	9	448	709	1157	1590	1952	11060	322	569
Greenville	974	351	330	0	191	105	426	207	571	1871	98	107
West Napa	2315	929	604	0	403	206	683	180	1313	2577	256	188

The data on daily occupancy load of Red Cross shelters were also examined. ABAG worked with George Washington University (GWU) to use these estimates in developing projections of shelter populations in future earthquakes in the San Francisco Bay Area. To generate these estimates, this group incorporates demographic factors of income, ethnicity and ownership – factors shown to predict the need for public shelter in past earthquakes and hurricanes – to predict peak shelter population in these future earthquakes.



The multi-family wood-frame housing units discussed earlier also represent a disproportionate share of the public shelter population because they tend to be occupied by people with few resources – the very poor, the very old, and the very young. Moreover, the current lack of incentives for investors to make retrofit expenditures for non-owner occupied multi-family property is exacerbated by the well-documented vagaries of attaining earthquake insurance.

**TABLE 4. PEAK SHELTER POPULATION FOR BAY AREA COUNTIES AND SELECTED EARTHQUAKE SCENARIOS**

County Data for Earthquake Scenarios	Alameda	Contra Costa	Marin	Napa	San Francisco	San Mateo	Santa Clara	Solano	Sonoma	TOTAL
Loma Prieta - Actual	772	0	0	0	1650	679	164	0	0	3,265
Loma Prieta - Modeled	1409	116	189	0	7865	130	807	1	0	10,517
Hayward Combined	60001	6989	1317	22	26198	1152	9145	793	595	106,212
Southern Hayward	38228	762	632	4	7765	151	7030	96	18	54,686
Northern Hayward	45493	5784	1239	15	10233	147	235	254	96	63,496
Healdsburg Rodgers Creek	2217	457	744	29	7411	45	42	103	9028	20,076
Maacama	235	7	13	14	1319	4	6	10	544	2,152
Peninsula Segment of San Andreas	2139	31	489	1	12905	7966	5447	6	0	28,984
San Gregorio	1392	18	493	1	7777	806	177	6	1	10,671
Northern Calaveras	4095	2261	14	9	1565	39	1866	102	0	9,951
Concord-Green Valley	2415	7342	14	768	2123	48	216	2172	22	15,120
Greenville	1654	1145	14	9	390	6	83	262	1	3,564
West Napa	1030	191	14	2736	1336	6	17	1284	72	6,686

These past earthquake experiences emphasize the importance of creating housing loss estimates useful for emergency response planning in metropolitan areas subject to strong ground shaking. They also point out the impacts of non-life-threatening damage on the lives of people, as well as the need to rethink the design and mitigation of damage to non-engineered structures.

Our goal has been to improve mitigation, disaster response and residential rebuilding efforts in future earthquakes. The project should help motivate people to retrofit their homes and apartments, as well as help people plan for and rebuild faster after earthquakes.





# ServiceMatters

abagOnline: <http://www.abag.ca.gov>

May/June 1996 • No. 22

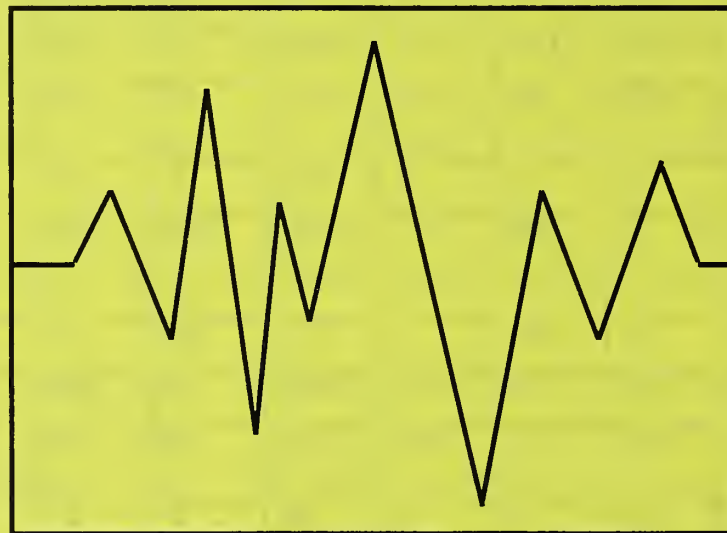
## SHAKEN AWAKE!

When the entire length of the Hayward Fault ruptures, more than 150,000 dwelling units will be uninhabitable, over 300,000 people will be forced from their homes, and more than 100,000 people will require public shelter, according to a report released recently by the Association of Bay Area Governments.

The report, *Shaken Awake!*, examines eleven earthquake scenarios and their estimated effects on housing and the post-earthquake demand for public shelter.

"Six of those earthquakes are expected to have a greater impact on housing than the Loma Prieta earthquake of 1989," said Jeanne Perkins, Manager of the Association's Earthquake Program and principle author of the report. "Three are expected to cause a greater housing crisis than the Northridge quake of 1994."

According to the report, the greatest housing impact would occur if the full length of the **Hayward Fault** ruptures (as



described above). The second greatest impact would occur during a quake on just the northern portion of the **Hayward Fault** (San Leandro north to San Pablo). In this scenario, 62,000 dwellings are expected to be uninhabitable in Alameda County alone, with a total of nearly 88,000 around the Bay. More than 63,000 people would require public shelter in this situation.

The third highest housing impact would be generated by the southern portion of the **Hayward Fault** (San Leandro south to Santa Clara County). In this scenario, 52,000 dwellings would be uninhabitable in Alameda County, and 11,600 in San Francisco — for a total of more than 76,000 housing units left uninhabitable in all nine counties combined. Almost 55,000 people would require emergency shelter.

Following the three scenarios for the Hayward Fault, the greatest impact is expected on the peninsula segment of the **San Andreas Fault**. Close to 46,000 dwelling units would be uninhabitable — 20,000 of them in San Francisco, more than 13,000 in San Mateo County, almost 10,000 in Santa Clara County, and more than 3000 in Alameda County.

→ See page 6 & 7

## LOCAL GOVERNMENT PROJECTS HONORED



Sixteen local government projects which received high marks for innovation in government service were honored on Friday, April 19 at the Spring General Assembly held at the Fairmont Hotel in San Jose.

A panel of experts — Angelo Siracusa, President of the Bay Area Council; Stephen Kroes, Research Director of the California Taxpayers Association; Nancy Ianni, Vice-President of the League of Women Voters of the Bay Area; Karel Swanson, Chief of Police of the City of Walnut Creek; and Ted Weinstein, Online Business Development Manager of Miller-Freeman — was convened by ABAG to review over 90 projects submitted by Bay Area local governments as examples of their most creative and successful approaches to addressing the challenges of delivering government services and responding to community needs.

The top sixteen projects range from a grassroots effort to fund needed capital improvements by the small community of **El Cerrito** to a large collaborative

effort of 30 **Silicon Valley** governments to develop a uniform building code. Overall, the projects represent efforts by a total of 53 governments, either individually or in partnership with neighboring cities, counties, school districts, and solid waste authorities.

The projects were selected by the panel for achieving significant cost savings for their jurisdictions or for streamlining complex and time-consuming processes. For example, the **City of Sunnyvale** was selected for eliminating over 70 steps in the process of obtaining a building permit.

Angelo Siracusa, Bay Area Council President, said the Sunnyvale project showed, “Bay Area governments are getting the message — creating a thriving business climate depends on the ability of government to move quickly when needed.”

In addition, many of the projects selected are excellent demonstrations of how governments have picked up private sector theories and technology and put them to good use. The **City of San Mateo**, for example, “re-engineered” their Recreation department, saving \$50,000 annually, while the City of San Francisco eliminated 15,000 vehicle trips per year between the City and **San Bruno** by installing

videoconferencing technology for probation officers and public defenders.

“We’re delighted to see cities and counties making significant progress like this without asking the public for more tax dollars,” said Stephen Kroes, Research Director of California Taxpayers Association.

The panel also applauded the governments sponsoring the projects for finding new ways to approach and conquer some of their most persistent problems. The **City of Concord**, for example, facing citizen complaints about day laborers congregating in front of a convenience store, shunned common disbursement methods in favor of creating a highly successful job placement center, which not only eliminated the congregating problem but also found hundreds of laborers temporary and permanent work.

Nancy Ianni, League of Women Voters of the Bay Area, was impressed with the creative approaches employed by the projects, “Some of these address intractable social problems that locals have struggled with for years,” she said. “I am hopeful that these innovations will serve as models for other communities, spurring even more progressive action.”



## SOUTH BAY

The Cities of San Jose, Mountain View, Santa Clara, Sunnyvale, with Joint Venture, Silicon Valley and the Santa Clara Valley Manufacturing Group led 29 other Silicon Valley local governments in reaching a consensus on a uniform package of building code amendments that reduced the number of requirements by 97 percent — from 400 to only 11 — while retaining critical life safety and building code enforcement regulations. *Contact: Andrew Adelman, Chief Building Official, City of San Jose, (408) 277-2830.*

The City of Sunnyvale worked with the Solectron Corporation to dramatically reduce the turnaround time and number of steps needed to obtain a building permit. The city eliminated 70 processing steps and simplified and/or shortened many others while maintaining the quality of permit review and compliance. *Contact: Hamid Pouya, Chief Building Official, City of Sunnyvale, (408) 730-7433.*

## EAST BAY

The Cities of Oakland and Berkeley created a Recycling Materials Development Zone to attract, retain, and expand businesses and nonprofits that use recycled materials to create



*Laborers from Concord display sign for job placement and referral program.*

marketable products. In its first two years, the Zone generated over \$8.2 million in investments and packaged \$4 million in loans and grants for businesses, resulting in retention of 135 jobs, the creation of over 155 new jobs, and the diversion of over 387,000 tons of material from local landfills. *Contact: Christie Beeman, Zone Coordinator, City of Oakland, (510) 238-3703.*

The City of Oakland created the Oakland Commerce Corporation in 1991 to increase employment opportunities by creating an economic climate that encourages business expansion, and by helping firms to overcome obstacles that might otherwise drive them out of business or away from Oakland. In its first three years (1992-95), the Corpo-

ration assisted in retaining 83 firms with 3,968 employees.

*Contact: Michael Ross, President, Board of Directors, (510) 632-1238.*

Citizen complaints about day laborers congregating in front of a convenience store led the City of Concord to work with the State to provide job placement and referral services based on a phone-match program. The program's achievements in its first four months of operation included registration of 210 workers, 348 job placements (24 of which are permanent positions), 296 service agency referrals, and virtual elimination of the streetside congregation problems. *Contact: Peter Dragovich, Senior Administrative Analyst, City of Concord, (510) 671-3085.*

The Cities of Walnut Creek



# BAY AREA INNOVATIONS

## WEST BAY (CONT.)

and San Ramon and the Central Contra Costa Sanitary District, which serves the Cities of Lafayette, Orinda, Moraga, and Danville, and Contra Costa County formed the Central Contra Costa Solid Waste Authority, negotiated a garbage export arrangement, and cut collection costs by putting an eight-year garbage, recycling, and yard waste services contract up for competitive bid.

These two actions saved the rate payers over \$12 million annually. *Contact: Janet Schneider, Administrative Analyst, City of Walnut Creek, (510) 256-3503.*

In 1991, the **City of Fremont** began to integrate laptop computers into existing Police records management and dispatch systems.

The new technology, placed in 92 vehicles, provides instantaneous access to time-sensitive information such as stolen vehicle data and provides access to police reports in under 24 hours, compared to up to ten working days under the old system. *Contact: Ray Torres, City of Fremont, (510) 790-6666.*

The **County of Alameda** created the Innovation Investment Program to encourage and sponsor innovative entrepreneurial ventures that will improve the way the County does business.



*The Emery-Go-Round, Emeryville's free shuttle to BART and Amtrak.*

To date, the County has invested \$1.3 million in projects such as technology improvements which are expected to return \$8 million or more to County coffers.

*Contact: Stella George, Management Analyst, County of Alameda, (510) 208-9708.*

The **City of El Cerrito** works in partnership with community organizations and citizens to fund capital improvements that all parties want but cannot afford on their own.

This new approach has raised over \$572,000 for capital improvements, projects ranging from street tree planting to construction of a new fire station. *Contact: Jim Randall, Administrative Services Manager, City of El Cerrito, (510) 215-4300.*

The **City of Emeryville** and seven major Emeryville developers and employers developed the

“Emery-Go-Round,” a free citywide public bus shuttle to BART and Amtrak.

The shuttle links the City’s major residential, retail, and employment centers, providing commute and lunch hour connections to the nearby MacArthur BART station and the Emeryville Amtrak station about every 15 minutes. *Contact: Karen Johnson Hemphill, Environmental Programs Manager, City of Emeryville, (510) 596-3728.*

## NORTH BAY

The **County of Solano** and the **Cities of Benicia, Fairfield, and Vallejo** formed a joint powers authority to cooperatively protect a 10,000-acre agriculture and open space area located between the three cities from development. *Contact: Harry*

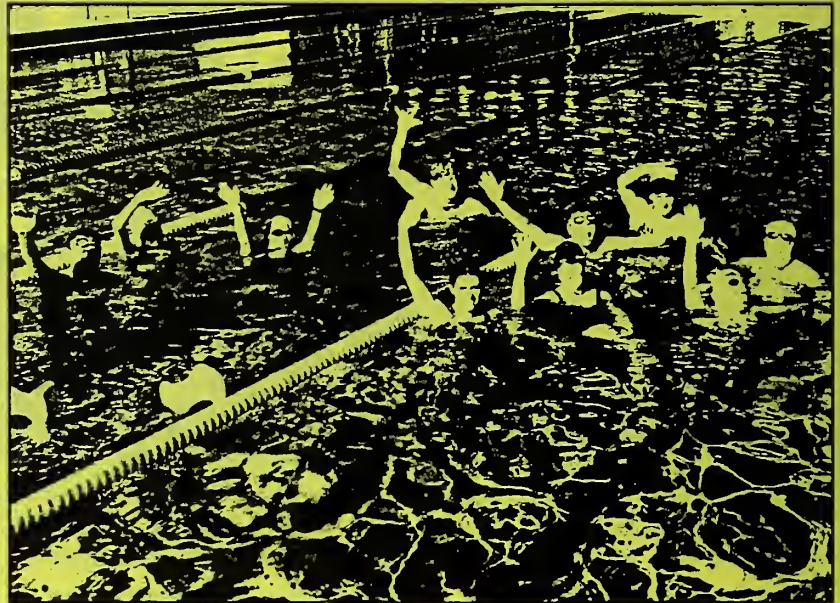
*Euglebright, Principal Planner, County of Solano, (707) 421-6765*

## WEST BAY

In 1994, the **City and County of San Francisco** used \$15,000 to purchase and install four videoconferencing sites at two jail facilities in San Bruno and at two San Francisco offices. The sites enable public defender staff to conduct inmate interviews and consultations without driving back and forth to San Bruno, saving an estimated 15,000 vehicle trips per year. *Contact: Rick Ruvolo, Commute Assistance Coordinator, City and County of San Francisco, (415) 554-6184.*

The **City of San Carlos and the San Carlos School District** pooled resources to create the "Technology Goes to School" program in which a city employee oversees the computer training, support, purchasing, and planning needs for both the city and the school district. This cooperative program saves over \$20,000, enabling the school district to obtain a \$50,000 grant for a data base of student video, audio, and writing samples. *Contact: Brian Moura, Assistant City Manager, City of San Carlos, (415) 802-4210.*

The **City of San Carlos** created a "Cost Avoidance Reserve," which acts as a form of "internal venture



*Community participation is the key to success for San Mateo recreation projects.*

capital" for investments in the City's future. These projects, initiated by City employees, are expected to save the City over \$330,000 for an investment of \$60,000. *Contact: Brian Moura, Assistant City Manager, City of San Carlos, (415) 802-4210.*

By re-engineering its Recreation Department, the **City of San Mateo** permanently reduced its subsidy to this department by \$50,000, while expanding programs and increasing community participation. Most of this progress resulted from relatively simple changes in the department's operating procedures. *Contact: Paul Council, Recreation Superintendent, City of San Mateo, (415) 377-3340.*

The **City of San Mateo**

negotiated a truce between two rival gangs who had been at war for several years, committing a myriad of crimes against each other, including murder. For nearly two years, the truce between these two gangs has held — there have been no reports of violence between the two groups. *Contact: Bob Szelenyi, Police Corporal, City of San Mateo, (415) 377-4530.*

All sixteen projects are featured in a special publication, *On the Cutting Edge: New Ideas for Local Government*, which is available from ABAG by calling (510) 464-7900. Project descriptions will also be available on the Internet through abagOnline at <http://www.abag.ca.gov>.



## HOUSING CRISIS FORECASTED FOR FUTURE EARTHQUAKE SCENARIOS AROUND THE BAY

(continued from Page 1)



*The parking garage level was completely flattened at this Northridge apartment complex. Structures with living space over garages are particularly vulnerable.*

Nearly 30,000 people would require shelter in this scenario for the **San Andreas Fault**.

The **Healdsburg-Rodgers Creek Fault** in the North Bay is expected to leave more than 30,000 dwelling units uninhabitable and 20,000 people in need of shelter.

The **Maacama Fault** in Sonoma County is expected to render 3,200 units uninhabitable and leave 2,000 people seeking shelter.

The **San Gregorio Fault** in San Mateo County is expected to generate more than 16,000 uninhabitable units, with almost 10,700 residents needing shelter.

The **Northern Calaveras Fault**, from Danville in Contra Costa County south to the Calaveras Reservoir in northern Santa Clara County, is expected to leave 15,500 units uninhabitable and nearly 10,000 residents homeless.

The **Concord-Green Valley Fault** in Contra Costa and Solano Counties is predicted to make approximately 23,500 units unlivable, with a shelter population exceeding 15,000.

The **Greenville Fault**, in Contra Costa, Alameda and Santa Clara Counties, will force residents from more than 5,200 units with 3,500 of them seeking shelter.

The **West Napa Fault** would generate nearly 10,000 uninhabitable dwelling units and would leave almost 7,000 people seeking shelter.

The *Shaken Awake!* report presents residential impacts by county and by housing construction type (wood, non-wood, unreinforced masonry); or mobile-homes; it also presents data based on the number of stories to the building and whether it was built before or after 1940 — all factors in the stability of the structure.

“Our research shows that most uninhabitable housing units will likely be multi-family dwellings rather than single family homes,” said Ben Chuaqui, a regional planner with the Association’s Earthquake Program. “Particularly vulnerable are those structures with living quarters built on top of ground floor parking structures.”

In the combined north-south **Hayward Fault** situation, almost 85,000 multi-family housing units are predicted to be uninhabitable. Under the same earthquake scenario, over 13,000 unreinforced masonry homes would be rendered uninhabitable, in addition to nearly 11,000 mobilehomes, and 7,500 single family homes.



*Shaken Awake!* is the culmination of two years of research combining computer modeling of earthquake shaking intensity, a survey of the Bay Area housing stock, and actual data from the Loma Prieta and Northridge earthquakes.

The report uses computer models designed to provide estimates of the number of "uninhabitable" dwelling units following major earthquakes—that is, single family homes that are "red-tagged" as unsafe buildings where entry is prohibited, and multi-family units that are red-tagged or "yellow-tagged" where entry is restricted.

"Uninhabitable buildings are not necessarily destroyed," said Perkins. "In fact, most can be repaired. However, the occupants will be forced to live elsewhere until repairs can be accomplished."



*This single family home, very similar to many houses in the Bay Area, saw extensive damage in Southern California. (Courtesy of Degenkolb Associates.)*

*Shaken Awake!* may be ordered by requesting an earthquake publications order form, and sending a self-addressed, stamped envelope to: **ABAG Publications, P.O. Box 2050, Oakland, CA 94604.** (Please, no phone orders. )

Earthquake shaking hazard maps and publications may also be viewed on the Internet through abagOnline at <http://www.abag.ca.gov>. (Click on "Bay Area Projects," then "Earthquake Information.")



The Association of Bay Area Governments

is pleased to present

## On Shaky Ground

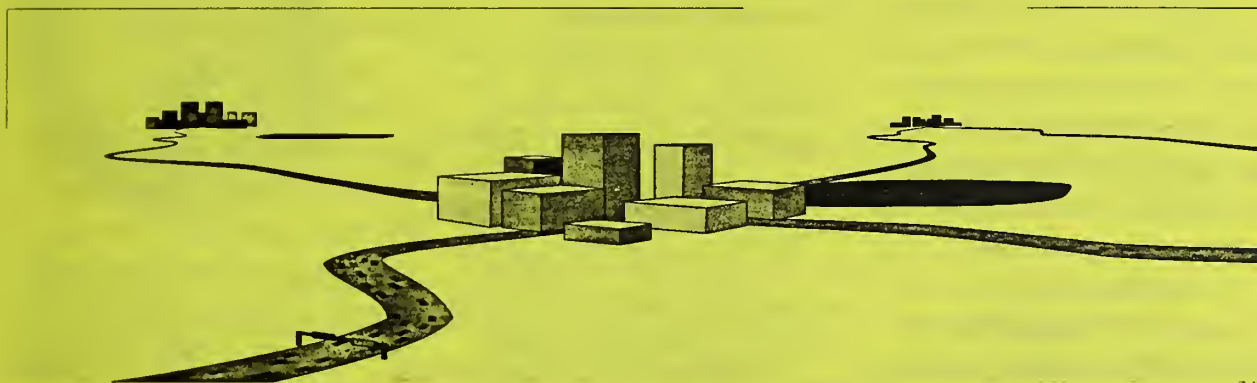
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*This CD-ROM is available for \$40, including tax and postage. To order, send a self-addressed, stamped envelope along with a request for an earthquake publications order form to: ABAG Publications, P.O.Box 2050, Oakland, CA 94604.*

## REGIONAL PLANNING COMMITTEE

### COMPACT DEVELOPMENT OR SPRAWL? OPPOSING VIEWS TO BE PRESENTED IN JUNE



A little over a year ago, a diverse group of interests sponsored a report entitled, *Beyond Sprawl: New Patterns of Growth to Fit the New California*. The sponsors included the California Resources Agency, Greenbelt Alliance, Bank of America, and the Low Income Housing Fund.

*Beyond Sprawl* concludes that the predominant pattern of urban and suburban development characteristic of the years since WWII, which fostered our economic and population boom in the past, now threatens to inhibit growth and degrade our quality of life.

The report advances four major premises: (1) more certainty is needed in delineating where new development should and should not occur; (2) more efficient use should be made of the land that has already been developed; (3) a legal

and procedural framework should be established to create the desired economic certainty for investors; and (4) we must forge alliances and a constituency to build sustainable communities.

*Beyond Sprawl* states that it "is not a call for limiting growth, but a call for California to be smarter about how it grows...."

A recently released report called *The Case for Suburban Development* was sponsored by the Building Industry Association (BIA) of Northern California and authored by two University of Southern California researchers (Peter Gordon and Harry Richardson).

This new report challenges the conclusions of *Beyond Sprawl* and also goes to the heart of policies adopted by the Association of Bay Area Governments aimed at fostering compact, city-centered

development and directing growth to areas with available infrastructure capacity.

The BIA-sponsored report presents some provocative conclusions including: agricultural land and other natural resources are not in short supply; compact development does not result in either increased transit use or in decreased trips; and in fact, suburban development significantly reduces traffic congestion. It also questions common policy responses to land use issues.

Join the Association's Regional Planning Committee in reviewing these two reports at its next meeting on **Wednesday, June 5, 1996 at 1:30 p.m.** in the MetroCenter Auditorium, 101 8th Street in Oakland. *For more information, call 510/464-7978 or e-mail [JeanP@abag.ca.gov](mailto:JeanP@abag.ca.gov).*



## MIGRATION STUDY SHOWS THE BAY AREA ATTRACTS WELL-EDUCATED WORKERS

In a region known for its highly skilled and educated work force, it might be surprising to learn that, on average, those persons moving into the region tend to be better educated than current residents and those leaving the area.

This was one of the conclusions presented in "Migration Patterns in the San Francisco Bay Area," a paper published recently by the Association of Bay Area Governments.

Information from the 1980 U.S. Census shows that persons with college or post-graduate education accounted for 22.1% of the region's population (ranging from 11.4% in Solano County to 34.3% in Marin County). Those numbers had increased by the 1990 Census to a regional average of 28.2% with college or post-graduate education (ranging from 16.6% in Solano County to 41% in Marin County.)

In comparison, 35.8% of those persons moving into the nine-county region during the years 1985 to 1990 had college or post-graduate degrees. (Incidentally, 43.9% of persons moving into Marin County had college or graduate education.)

### The Racial Dimension

Between 1965 and 1970, Caucasian and African American migrants constituted eighty-two percent of the Bay Area's total "net migrants" (the difference between the number of those moving into and out of the area). By the period from 1985 to 1990, they represented only a meager portion of the net migrants.

Asians Americans now account for the vast majority of the region's net migrants. During the 1985-1990 period, nearly 150,000 more Asians moved into the area than moved away. This compares to 12,000 Caucasians, and 236 African Americans as net migrants.

Statewide, Asians make up 30 percent of the net migration flow and less than 10% of the total population. But in the Bay Area, Asians account for 77% of the net migration flow and 15% of the population.

### Personal Income Levels

The migration study also showed that persons moving into and out of San Mateo County are the wealthiest in the region; the median personal income among these categories ranks equivalently with the non-moving residents of Marin County. (These rankings coincide with the high cost of housing in these two counties.)

The next highest income levels are found among those persons moving into Contra Costa County, non-moving residents of San Mateo County those moving within the county, and person moving out of San Francisco.

Much more information may be found in this paper authored by Chin Ming Yang, Paul Fassinger, and Julie Woo. *Please contact Chin Ming Yang at 510/464-7925 or e-mail ChinY@abag.ca.gov.*





## NEW SUBREGIONAL PLANNING GRANTS!!



The Association has developed a unique approach to craft consistent conservation and development strategies on a subregional basis. It relies on voluntary cooperation among neighboring jurisdictions, while providing technical assistance and financial support. Initial results and feedback from two pilot

projects (one in the Tri-Valley and one in Sonoma) have been quite positive. Thus we are eager to continue the program and are soliciting proposals for two new projects. A total of \$125,000 is committed for both the new projects, and follow-up implementation for the initial pilot projects (this sum includes a generous \$25,000 contribution from the Bay Area Air Quality Management District).

Requests for proposals have been sent to city managers, county administrators and planning and community development directors throughout the Bay Area. The

project scope, along with the geographic extent of a subregion, will be locally defined. However, projects must be comprehensive and address: the location and intensity of urban development (urban form), mobility, housing supply and affordability, natural resources protection and management, and economic vitality.

We optimistically await excellent project submittals. Proposals are due by Friday, June 7. A group of Regional Planning Committee members will review all proposals and make recommendations to the Executive Board; final Board selection is expected in July.

### WIRELESS COMMUNICATIONS WORKSHOP THURSDAY, MAY 30, 1996 — 9 AM TO 4 PM OAKLAND MARRIOTT CITY CENTER

Wireless technology opens a new world of possibilities as a communication tool of today and the future. Join community leaders, decision makers, industry experts and government representatives to discuss the future of wireless communications, share concerns and goals, and what it means for our communities.

*Registration Mandatory - Deadline: Thursday, May 16, 1996.*

*Members: \$40 Non-Members: \$60*

*For registration information, please call Kathi Carkbuffat*

*(510) 464-7960, or e-mail KathiC@abag.ca.gov.*

Keynote Address - **Dr. Harry Saal**,  
Former CEO & President of Smart Valley, Inc.,  
*"Information Infrastructure and the  
Regional Economy"*

also:

The Wireless World:

Maximizing Technological Opportunities

The Telecommunications Bill

Notional Health and Safety Standards

Wireless in the Bay Area:

- Network Design and Site Selection Process
- The Local Government Perspective with City and County Panelists

## Prop. 62/Guardino Refunds

Has a business in your community filed claims demanding refunds of taxes paid prior to the Guardino decision? Upon request by your city, the League of California Cities will send a letter to that business explaining why cities have had to raise taxes over the last few years, and asking that the business reconsider its request in the spirit of private and public shared responsibility.

For more information, contact Debbie Thornton, League Communications Director, at 916/659-8228.

## Gearing for the Graying of America

Initiating a review of the future of the Social Security system, a White House Advisory Commission has proposed a series of controversial reforms. Debating proposals permitting the investment of Social Security taxes in stocks (as opposed to federal securities or bonds), the commission disagreed over whether individuals could invest in the private market, or whether a board should be responsible for investing a portion of Social Security trust fund revenues.

*Nations Cities Weekly*. April 1, 1996.

## Tax Cuts Dissuade Economic Development

According to a Washington, D.C.-based think tank, cutting state and local taxes is ineffective in spawning economic growth. Reducing taxes, the Economic Policy Institute holds, drives governments to reduce the very services which businesses consider foremost in relocation and investment decisions — such as the cost and availability of labor, and proximity to universities and markets. Ironically, education, training, and infrastructure are the areas generally reduced by local governments as compensation for tax cuts.

*Land Use Law Report*. April 17, 1996. (301) 587-6300.

## Cities & Towns: Prepare for Cost-of-Cable Complaints

The Federal Communications Commission (FCC) has issued a statement instructing consumers upset with cable rates to direct their complaints to cities and

towns. According to the Telecommunications Act of 1996, states and local governments are solely responsible for issuing complaints to the FCC. Cable rates for most of the nation's 62 million cable subscribers will be deregulated within the next three years. *Nation's Cities Weekly*. Published by the National League of Cities. April 15, 1996.

## Slouching Toward Suburbanized Services

The cost of extending urban services — such as roads, sewers, water, and schools — to new suburbs proves more expensive than the revenue cities gain from expansion, according to a study of the American Farmland Trust. Developers disagree, however, arguing that growth boundaries impose urban living on those who prefer suburban life.

*Christian Science Monitor*. April 17, 1996.

## The Dawn of Electronic Investment

Embracing the digital revolution, Anaheim has invested \$6 million to connect its electrical substations with a 50-mile ring of fiber-optic cable. Three times the infrastructure required to maintain these electric utility needs, the city plans to sell the surplus cable to private telephone, video, and telecommunications service companies.

*Governing*. April 1996.

## CA Supreme Court Rules on Impact/Development Fees

In a long-awaited decision, the California Supreme Court strengthened the hand of government regulators, upholding local authority to impose mitigation fees on developers for a change in land use designation. The ruling, *Ehrlich v. City of Culver City* maintained the City's right to assess fees for a development on land zoned for commercial recreation. The court emphasized, however, that the high court's rules govern only specific development fees, while freeing most fees in California from meaningful judicial examination.

Washburn, Briscoe & McCarthy. April 22, 1996.



# CALENDAR

**May 13 & 14. 8:30 a.m.** 2-Day Action Project Management. MetroCenter Auditorium, Oakland.

**May 14. 3:00 p.m.** San Francisco Bay Trail Steering Committee. Hayward Shoreline Interpretive Center.

**May 14. 5:00 p.m.** Bay Trail Wildlife Study Public Meeting. Hayward Shoreline Interpretive Center.

**May 16. 3:30 p.m.** Legislation and Governmental Organization Committee. ABAG Room 106B, MetroCenter, Oakland.

**May 16. 5:00 p.m.** Finance and Personnel Committee. ABAG Room 102A, MetroCenter, Oakland.

**May 16. 7:30 p.m.** Executive Board. MetroCenter Auditorium, Oakland.

**May 17. 10:00 a.m.** Regional Steering Committee on Homelessness. Room 171, MetroCenter, Oakland.

**May 29 & 30. 8:00 a.m.** 16-Hour HazMat Sampling. Room 171, MetroCenter, Oakland.

**May 30. 9:00 a.m.** Wireless Communications Workshop, Oakland Marriott City Center.

**June 5. 1:30 p.m.** Regional Planning Committee. MetroCenter Auditorium, Oakland.

**June 12. 8:00 a.m.** 8-Hour OSHA Annual Refresher for Hazardous Waste Personnel. ABAG Training Center, MetroCenter, Oakland.

**June 18-20. 8:00 a.m.** 16-Hour HazMat Sampling. ABAG Training Center, MetroCenter, Oakland.

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**Service Matters is a publication of the Association of Bay Area Governments, the planning and services agency for the San Francisco Bay Area's 9 counties and 100 cities.**

**Councilwoman Charlotte Powers, President; Supervisor Mary King, Vice President; Supervisor Tom Torlackson, Immediate Past President; Eugene Y. Leong, Secretary/Treasurer and Executive Director.**


**Michelle Fadelli, Editor. Jeannie Yee Balido, Associate Editor. Marcie Adams, Contributing Writer.**

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**The San Francisco Bay Area — On Shaky Ground**, April 1995, 56 pages. Describes the shaking hazard in the Bay Area and options for mitigation. Includes 14 maps of the San Francisco Bay Area at a scale of 1 inch = 16 miles showing:  
 [1] earthquake faults, [2] geologic materials; [3] ground-shaking intensities from Loma Prieta and 11 possible future earthquake scenarios.  
 Price: \$13 + \$3 postage and handling; CAT. NO. P95001EQK

**Multi-Media CD-ROM — On Shaky Ground**, April 1996. Includes the text and maps from the report above as well as the city maps listed below. Includes video clips on how to retrofit homes, animated graphics, earthquake damage photos.  
 Price: \$35 + \$5 postage and handling; CAT. NO. P96003EQK  
 Special: CD-ROM w/Shaken Awake! (See back) \$40 + \$7 postage & handling

**On Shaky Ground — City Maps**, April 1995. City maps include local streets and show:  
 1) geologic materials, and 2) ground-shaking intensities for significant scenarios where significant damage potential has been identified. **CIRCLE MAPS ORDERED.**  
 \$4 p/h\*\* first 4 maps, \$1 for each additional map, \$15 max. CAT. NO. P95002EQK.

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  - \$ 6 SON-2 Healdsburg
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NEW CD-ROM



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New

On Shaky Ground — Computer Files, April 1996. Includes: geologic materials amplification and ground-shaking intensities for 11 scenarios. Requires GIS system such as ArcInfo. Available in \*.cas, \*.dlig, \*.bdf, and ArcInfo polygon coverage. (12 layers, one for each scenario). Specify desired layers and format when ordering. Price: \$125 per EACH data layer + \$5 postage and handling CAT. NO. P96005EQK.

Regionwide Earthquake Secondary Hazard Maps for Dam-Failure Inundation Areas, and Liquefaction Susceptibility. These two maps cover the entire nine-county region. The maps are blue-line single-color ozalid prints, rather than color printed maps. The map scale is 1:250,000; each map covers the region and is approximately 42" x 48". Please allow 4 working days for the prints to be ordered from the blue-line printing company. Price: \$10 + \$7 postage and handling; CAT. NO. P95003EQK.

#### HOUSINGANDECONOMICIMPACTS

New

Shaken Awaken Estimates of Uninhabitable Dwelling Units and Peak Shelter Populations in Future Earthquakes Affecting the San Francisco Bay Region, April 1996, 144 pages. Estimates the number of housing units likely to be uninhabitable, displaced populations, and people requiring public shelter following 11 likely future earthquakes. The scenarios are identical to those in *On Shaky Ground*. Research was conducted by ABAG and George Washington University. Price: \$15 + \$5 postage and handling; CAT. NO. P96002EQK. Special: CD-ROM w/Shaken Awaken Both \$40 + \$7 postage & handling. CAT. NO. P96004EQK.

New

Shaken Awaken Uninhabitable Housing Files for Loma Prieta, January 1996. A PC-compatible diskette of the locations and characteristics of the housing units rendered uninhabitable by the Loma Prieta earthquake. Format: \*.dbf. Price: \$25 + \$5 postage and handling; CAT. NO. P96001EQK.

Macroeconomic Effects of the Loma Prieta Earthquake, November 1991, 48 pages. Includes an analyses of the impacts on employment, retail sales, wages, and output. Additional analysis is included for two hypothetical future earthquake scenarios. Conclusions highlight the small impact of this earthquake on the region's economy and the importance of functioning infrastructure in minimizing economic impacts in future earthquakes. Price: \$7 + \$3 postage and handling; CAT. NO. P91001EQK.

#### EARTHQUAKESANDHAZARDOUSMATERIALS

Hazardous Materials Problems in Earthquakes:

Report: A Guide to their Cause and Mitigation, November 1990, 72 pages. Types of releases in past earthquakes, ways to assess and minimize risk, emergency response lessons, employee education programs, and program motivations. Price: \$12 + \$3 postage and handling; CAT. NO. P90002EQK.

Executive Summary, November 1990, 6-page brochure. Short summary of hazardous materials releases in past earthquakes and mitigation techniques. Price: \$3 + \$1 postage and handling; CAT. NO. P90003EQK.

Background Materials, September 1990, 281 pages. A volume containing selected articles and papers dealing with hazardous materials problems in earthquake and mitigation strategies. Price: \$15 plus \$5 postage and handling, CAT. NO. P90001EQK.

DATABASE, September 1990

A PC-compatible diskette of over 350 hazardous materials problems in 28 past earthquakes, including over 150 from the Loma Prieta earthquake. Format: \*.dbf. Price: \$20 + \$3 postage and handling; CAT. NO. P90005EQK.

Toxic Gas Releases in Earthquakes: Existing Programs, Sources, and Mitigation Strategies, November 1991, 374 pages. A binder containing three documents prepared by ABAG for the South Coast Air Quality Management District in Los Angeles region: 1) Review of Emergency Preparedness Programs for Preventing or Controlling Toxic Gas Releases in Earthquakes; 2) Sources of Toxic Gas Releases in Earthquakes; and 3) Manual of Techniques for Preventing or Controlling Toxic Gas Releases in Earthquakes. Price: \$20 + \$5 postage and handling; CAT. NO. P91002EQK.

#### LOCAL GOVERNMENT LIABILITY

The Liability of Local Governments for Earthquake Hazards and Losses:

Report: A Guide to the Law and Its Impacts in the States of Alaska, California, Utah and Washington, February 1989, 52 pages. Includes discussions on rules governing the legal liability of local governments for earthquake hazards and losses, the effect of liability rules on earthquake safety mitigation programs, several hypothetical situations, and approaches for using liability to promote safety. Price: \$12 + \$3 postage and handling; CAT. NO. P88003PLN.

Executive Summary, February 1989, 8-page brochure. (Multiple copy discount.) Price: \$3 + \$1 postage and handling; CAT. NO. P89001PLN.

Background Research Reports, October 1988, 295 pages. Includes the text of three background reports prepared for a project on earthquake hazards and local government liability: [1] Update on Local Government Liability for Earthquake-Related Injuries and Damages; [2] Key Statutes and Cases; and [3] The Impact of Tort Liability on Local Government Programs Related to Earthquake Hazards and Losses. Price: \$15 + \$5 postage and handling; CAT. NO. P88004PLN.

#### BUSINESSANDINDUSTRY LIABILITY

The Liability of Businesses and Industries for Earthquake Hazards and Losses:

Executive Summary, April 1984, 8-page brochure. (Multiple copy discount.) Price: \$3 + \$1 postage and handling; CAT. NO. P84003EQK.

Background Research Reports, September 1984, 199 pages. Includes the text of five background reports prepared for a project on earthquake hazards and liability: [1] Private Sector Tort Liability: Safety Incentives, and Earthquakes; [2] Perceptions of Experts on Earthquake-Related Knowledge; [3] Tort Liability of Private Businesses and Industries for Earthquake Hazards and Losses—A Review of Current California Law; [4] The Impact of Tort Liability on the Willingness of Companies to Mitigate Earthquake Hazards; and [5] Approaches for Improving Tort Liability Effectiveness in Promoting Earthquake Safety. Price: \$15 + \$5 postage and handling; CAT. NO. P84005EQK.





THE CALIFORNIA POLICY SEMINAR  
IS A JOINT PROGRAM OF THE  
UNIVERSITY OF CALIFORNIA  
AND STATE GOVERNMENT

## RESIDENTIAL EARTHQUAKE RECOVERY Improving California's Post-Disaster Rebuilding Policies and Programs

Mary C. Comerio, John D. Landis, and Catherine J. Firpo,  
with Juan Pablo Monzon

In the five-year period between 1989 and 1994, earthquakes, hurricanes, and floods took a heavy toll on America's housing stock. Two hurricanes, Hugo and Andrew; two earthquakes, Loma Prieta and Northridge; and one 100–500-year flood in the Midwest, caused \$75 billion in damage, half of it in residential structures. More than 200,000 housing units were completely destroyed or substantially damaged. An additional 600,000 housing units required significant repairs.

Between 1989 and 1994 California alone suffered 13 federally declared disasters. On January 17, 1994, California's streak of bad luck culminated in the 6.8 magnitude Northridge earthquake. Northridge would quickly become the most expensive earthquake ever to strike the United States. It would also change the way California planners and policymakers would look at natural disasters, shifting their emphasis from preparation and relief issues, to those concerning recovery. Many of the lessons of Northridge were immediate; others are only now being learned and applied.

This report examines the current state of earthquake recovery practice in California, with special emphasis on housing recovery. Public and private payments for residential rebuilding in the aftermath of Northridge have so far totaled \$12–13 billion, or about 50–60% of the total recovery cost.<sup>1</sup> In this report, we consider the complementary and overlapping roles of different federal, state, private, and nonprofit recovery and rebuilding institutions. We look at what has been learned since the Loma Prieta earthquake of 1989 regarding residential response and recovery policy. And we take a new and closer look at the distribution of post-Northridge rebuilding funds.

We draw two fundamental lessons from our analyses. The first is that while California state and local officials and federal disaster response agencies have made improvements in preparing themselves to provide emergency relief in large urban disasters, *no equivalent level of preparation has gone into the much bigger task of*

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*coordinating and paying for post-disaster rebuilding. Second, even though scientists are confident that another disaster of the same magnitude as the Northridge earthquake will occur in the reasonable future, we cannot expect that private insurers or federal agencies will be willing or able to compensate victims with a comparable level of rebuilding assistance.*

State policymakers and agencies must give much more attention than they have in the past to the challenge of paying for earthquake recovery. The recently enacted law establishing the California Earthquake Authority is a welcome step in this direction, but it is only a start. We believe that a reorganized and refocused system of providing public and private rebuilding assistance, linked to improved incentives for earthquake mitigation (particularly residential retrofitting), holds the most potential for significantly reducing public and private post-disaster rebuilding costs.

## STATE AND FEDERAL DISASTER RESPONSE AND RECOVERY PROGRAMS

California has a tradition of strong home rule that guides all state policy including disaster preparedness and response. When a disaster strikes, local police, fire, and emergency management entities respond to the needs of the jurisdiction, using local resources. If an emergency exhausts the resources of local governments, assistance is requested through a system of mutual aid coordinated by the California Governor's Office of Emergency Services (OES). In the event of a catastrophe, the state may request assistance from the Federal Emergency Management Agency (FEMA) and other federal agencies. Federal funding for relief and recovery activities is officially triggered by a presidential declaration of disaster.

In the event of a major earthquake or other large disaster, the focus of the first 24–48 hours is exclusively on emergency response and relief: controlling fires, rescuing victims, providing medical assistance, and securing food and shelter for displaced victims. These activities are largely in the domain of the local government and charitable relief organizations such as the Red Cross.

Representatives of federal agencies typically arrive on

the scene to provide assistance several days after the event itself. Whereas OES acts as California's coordinator of disaster response, FEMA serves that role among federal agencies and departments. FEMA also provides funds for public as well as individual assistance. For property owners, businesses, or households lacking disaster insurance,<sup>2</sup> the Small Business Administration (SBA) provides rebuilding loans at below-market rates. In some circumstances, the U.S. Department of Housing and Urban Development (HUD) may be asked to provide special financial assistance for housing. Depending on what is damaged and what services are required, dozens of other federal agencies (e.g., the departments of Agriculture, Education, Health and Human Services, Transportation, Veterans Affairs) may also step in to provide funding and assistance.

This system of disaster response and recovery has evolved over time. It was initially developed to provide federal funding for restoration of public functions and repair of public buildings and infrastructure—a tradition that culminated in the modern creation of FEMA in 1979. Since the 1950s, the provision of rebuilding assistance to private citizens and businesses has been the responsibility of the Small Business Administration through its various low-interest loan programs.

Until Hurricane Hugo and the Loma Prieta earthquake struck in 1989, large-scale property losses were the exception, not the rule. The dramatic 8.4 magnitude Alaska earthquake of 1964, and the 6.6 magnitude 1971 San Fernando earthquake, each damaged fewer than 2,000 housing units. With a very few exceptions (Hurricane Camille in 1969), natural disasters almost never seemed to strike major cities or suburban areas. This kept damage estimates, private insurance payouts, and overall public reconstruction costs fairly low—typically less than \$1 billion.

Hurricane Hugo and the Loma Prieta earthquake were quickly followed by a series of “urban” disasters of unprecedented scale: the 1991 Oakland hills fire, Hurricane Andrew in 1993, the midwestern floods of 1993, and the 1994 Northridge earthquake. These disasters tested state and local disaster response agencies, while at the same time significantly raising the costs of recovery.





Government disaster response agencies adapted to the heightened demands made on them primarily by increasing the scale of their existing services. The realization that the response and recovery needs associated with large-scale urban disasters differed fundamentally from those associated with localized floods, tornadoes, and small earthquakes came much more slowly.

For many agencies, one approach to improving responsiveness was to begin relief and recovery services even as they were undertaking their initial damage assessment. Especially in the case of large disasters, these attempts to combine expedited relief and recovery services often ended up at cross purposes. The overworked volunteers and government employees who staff Disaster Application Centers (DACs) simply could not handle all of the needs of all of the victims at the same time. Victims who had lost everything required a wide array of financial assistance and social services to help reestablish their lives; others with only minimal losses were ready to apply for simple home repair loans. Too often, both groups found at the DAC that they had to stand in line to obtain application forms for a mystifying array of grant and loan programs, each with different eligibility criteria, specialized forms, and bureaucratic procedures.

For victims, the process of finding assistance that would meet their needs was confusing and slow. For agencies, the pressure to provide help quickly meant that they had to initiate programs before they had a complete understanding of the scope of the losses. Moreover, agencies often applied their full arrays of disaster relief and recovery programs, even when particular programs were not entirely applicable to the circumstances.

In the wake of so many disasters, there was little time for careful analysis and review of policies and programs. Institutional learning was directed instead toward answering the question, "What can we do to avoid the problems of the last disaster?"

Nonetheless, each disaster brought about important improvements in procedures and practices. The most

significant of these came in the areas of emergency response. Emergency communication problems after the Loma Prieta earthquake led to the development of a statewide satellite communications system. Lessons learned in the Oakland hills fire led to the development of standardized emergency response procedures. Agency and volunteer staff received training in cultural sensitivity and language in response to criticisms of uneven services for minority victims. Oakland's one-stop-shop service center, established so that fire victims could do everything from collecting mail to applying for assistance and building permits, became a state model for expediting government services.

Temporary housing assistance was also improved. FEMA worked to develop procedures that would expedite funds for temporary housing. HUD was brought in after Hurricane Andrew and the Northridge earthquake to expand temporary housing assistance with Section 8 housing vouchers. After Northridge, the

*It is not surprising . . . that disaster assistance has come to be perceived as something of a boundless entitlement program.*

federal government committed tremendous resources to all its disaster assistance programs.

Even as disaster relief programs were being expanded and improved, the media were personalizing the victims—bringing the suffering and tragedy into America's living rooms. With cameras rolling, politicians rushed to deliver more dollars and services than ever before. They quickly became lobbyists for their local constituencies, thereby raising expectations among citizens and local governments. It is not surprising, therefore, that disaster assistance has come to be perceived as something of a boundless entitlement program.

Despite the extra federal funding available, there were fewer innovations in the area of reconstruction finance. The various federal programs providing small grants and low-interest loans gave out more money, but because these programs were designed to assist homeowners they provided little help to the many owners of damaged multifamily structures. Recognizing this gap in the immediate aftermath of the Loma Prieta earthquake, California quickly created its own California Disaster





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Assistance Program (CALDAP) to serve as a reconstruction lender of last resort for homeowners and rental property owners. Unfortunately, CALDAP soon ran out of money and was not recapitalized. Even in the aftermath of the Northridge earthquake, voters rejected bond measures to restart the program.

In Los Angeles in the days and weeks after Northridge, the City of Los Angeles tried to assume this function. Starting with the mayor, city officials appealed to HUD for supplemental appropriations of Community Development Block Grants and HOME Investment Partnership funds. Ultimately, more than \$200 million in supplemental HUD funds were made available, which the city used to finance repairs on 12,000 units that could not qualify for SBA loans. Whether another city lacking the size and political clout of Los Angeles would have been equally successful in obtaining such funding is an open question.

### THE INSURANCE PROBLEM

Although the state began requiring insurance companies to offer earthquake insurance with homeowners' policies in 1985, only 20% of Californians carried earthquake insurance at the time of the Loma Prieta earthquake. Californians neglected to buy insurance for many reasons: it was too expensive; it wouldn't happen to them; the deductible was too high; lenders didn't require it. Most importantly, many people believed that the federal government would ultimately bail them out.

Similarly, the concept of retrofitting (i.e., upgrading existing structures to better withstand earthquake forces) was a relatively novel idea. Efforts to encourage Californians to voluntarily mitigate against earthquake hazards in their homes have largely fallen on deaf ears. In 1991, the legislature passed a bill requiring the installation of foundation anchors in single-family homes at the point of sale, but it was vetoed by then-Governor George Deukmejian. Instead, a much weaker bill was passed the next year requiring "disclosure" of seismic conditions at the point-of-sale. Had the original bill passed, 25% fewer homes in California would now be vulnerable to earthquake damage.

Today, when more Californians have earthquake

insurance (40% in urban coastal areas and 30% inland) than ever before, insurance companies are raising legitimate concerns about adequate pricing, about their exposure to risks, and about a lack of reinsurers. Under current circumstances, insurers argue, the only alternative to the state's requirement that all homeowner policies be accompanied by earthquake insurance is for them to cease doing business in California. Geographic concentrations of policies in high-hazard areas, they argue, could easily lead to insolvency.<sup>3</sup>

The commissioner of the California Department of Insurance has responded to these threats by proposing legislation that was recently enacted to establish the California Earthquake Authority (CEA). The CEA would create a \$12 billion pool of tax-exempt funds that will cover earthquake losses to homeowners who have purchased a CEA "mini-policy" insuring their home and its contents. Significantly, damage to pools, garages, garden walls, and other appurtenant structures will not be covered. The establishment of the CEA begins to address the need to find an actuarially sound and affordable solution to the problem of disaster losses. However, it falls far short of being a policy to fully finance post-disaster residential reconstruction.

### NORTHRIDGE REEVALUATED

On January 17, 1994 a 6.8 magnitude earthquake on a blind thrust fault rocked the San Fernando Valley in the City of Los Angeles and changed forever the way Californians would approach earthquakes and other natural disasters. In terms of ground-shaking and duration, the Northridge earthquake—as the event would soon be known—was only a moderate earthquake. In terms of its impact on everyday life in the Los Angeles Basin, it was a much bigger event. Sections of six freeways collapsed and 27 bridges were damaged. Some 450 public buildings (schools, libraries, recreation centers, and offices) suffered significant damage, as did utilities such as water, power, and sewer. Six thousand commercial buildings were damaged. Although Californians remember the dramatic news photos of the collapse of the parking garage at Cal-State Northridge, the Northridge Fashion Mall, and the Kaiser Medical Building, the majority of the damage to





public and commercial structures was in one- and two-story wood-frame buildings, mini-malls, and shopping strips.

Most affected was housing. Inspection records, collected by local building departments and organized into a database by the California Governor's Office of Emergency Services, counted serious structural damage to 49,000 housing units in 10,200 buildings (7,500 single-family and mobile homes, and 2,700 multifamily structures). Minor—but not inexpensive—damage was reported in another 388,000 housing units in 85,000 structures. The total value of the damage to houses in Los Angeles County<sup>4</sup> was estimated to be about \$1.5 billion.

A closer look at the OES inspection database reveals that the damage was both concentrated and dispersed. Although significant damage occurred to homes as far away as 30 miles, two-thirds of the housing units damaged by the earthquake were located within 12 miles of the surface fault-rupture projection line.<sup>5</sup> (Ninety percent of the damaged units were located within 20 miles of the fault-rupture projection line.) Three-quarters of the dollar value of damage to single-family homes, and 90% of the dollar value of damage to multifamily structures, occurred within just 10 miles of the fault-rupture line. *Within this 10-mile radius, the number of damaged housing units and the dollar value of damage varied mostly according to the intensity of ground-shaking and the age and design of individual structures.* Ironically, houses in neighborhoods developed prior to 1950 often sustained less damage than houses in areas developed after 1960. Beyond 10 miles, the number of homes damaged and the value of the damage declined with distance to the fault-rupture line.

Our analysis of the OES inspection data—upon which the commonly quoted \$1.5 billion estimate of residential damage is based—reveals them to be seriously incomplete. The OES inspection database appears to be reasonably complete in its counts of significantly damaged apartment buildings (those that include red-tagged and

yellow-tagged units) and damaged single-family homes, particularly in Los Angeles County. It is far less reliable in its tabulations of damage to residential structures in Ventura County, and of nonstructural (i.e., “green-tagged”) damage to multifamily structures and units. And it is even more unreliable in its estimates of the dollar value of damage.

We note these problems not to criticize the hundreds of building inspectors who carefully and diligently responded to almost a half-million inspection requests. Nor do we wish to criticize the OES for its efforts to gather and tabulate many different inspection forms and records. Rather, we note them to make two related points. The first is that it is nearly impossible to obtain quick and reliable estimates of the *value* of damage to dispersed private property from large-scale natural disasters. This is particularly true in the case of housing. The second point is that given this difficulty, public policymakers, disaster response and recovery officials, well-meaning staff of agencies and relief organizations, and private insurers should all refrain from making quick judgments regarding the scale and scope of rebuilding programs, policies, and payments. Disaster response and recovery organizations should focus on quickly providing emergency shelter for those who need it, and on connecting victims with appropriate aid and recovery organizations. These initiatives worked very well in the hours and days immediately after Northridge. Building inspectors should focus on establishing the immediate habitability of damaged structures. *Questions of damage and loss appraisal should wait until the extent of the physical damage has been completely assessed.*

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## TOTALING THE COST OF RESIDENTIAL REBUILDING

We estimate the actual cost of residential rebuilding from the Northridge earthquake at \$12–\$13 billion. This total includes private insurance settlements; SBA loans; HUD loans and grants administered by the City of Los





Angeles; and FEMA Minimum Home Repair grants. It does not include FEMA temporary housing assistance or HUD Section 8 housing vouchers. Nor does it include additional equity provided through private bank refinancing, or private savings.

Between two-thirds and three-quarters of the cost of post-Northridge residential reconstruction—\$8–\$10 billion—has taken the form of private insurance payouts. Because this amount was so large, and because it significantly exceeded the amount collected through premiums, private insurers argue that state laws requiring them to offer earthquake insurance may very well bankrupt them should another earthquake of Northridge magnitude and impact occur in the foreseeable future.<sup>6</sup>

As part of this research effort, we obtained data covering Northridge insurance claims and coverage for all of the state's major property insurers as of March 1995.<sup>7</sup> The data covered 160,000 insurance claims in more than 250 zipcodes organized into six policy types: condominium policies, earthquake policies, fire policies, homeowners' policies, mobile home policies, and renters' policies.<sup>8</sup> Average payouts by policy type ranged from \$5,248 for renters' policies, to \$44,582 for earthquake policies. Payouts under homeowners' policies, which accounted for 65% of total claims, averaged \$23,083.

The insurance data yielded a number of surprising results when analyzed by zipcode and distance from the fault-rupture projection line. First, the number and amount of payouts occurred over a wider area than was apparent from local inspection records. According to those, the vast majority of the damage (whether measured in terms of units or dollars) occurred in zipcodes within 12 miles of the fault-rupture line. By contrast, a significant share of insurance payouts occurred to policyholders in zipcodes beyond 12 miles.

Second, claims rates (defined as the number of claims divided by the number of policyholders), although generally declining with distance, were still fairly high 10 miles from the fault-rupture line. Moreover, claims rates varied widely by policy types. Claims rates for earthquake riders to fire and condominium policies, and to individual earthquake policies, all exceeded 50% in zipcodes as far away as 12 miles from the fault-rupture line. Claims rates

for the earthquake riders on homeowners' policies (the most common form of earthquake coverage) were typically much lower. Also higher than expected—regardless of distance and policy type—were claims rates for contents and appurtenant structure losses. Damage loss rates (defined as claimed losses divided by coverage) were also higher than expected, and declined at a slower rate than expected.

For insurance companies, the combination of claims rates and damage loss rates provides a measure of loss exposure. The results of our analysis suggest that many insurance companies may have systematically underestimated their financial exposure to moderate earthquakes in urban and suburban areas.

After private insurers, the Small Business Administration was the second largest source of residential rebuilding funds. The SBA made nearly 75,000 low-interest loans to homeowners and 8,000 loans to renters, totaling \$2.3 billion and \$147 million, respectively. The average SBA homeowner's loan was for \$30,700.

Other significant sources of funds for residential reconstruction included the Federal Emergency Management Agency (\$841 million in grants under the Minimum Home Repair program to 288,000 recipients, averaging \$2,900 per grant), and the U.S. Department of Housing and Urban Development (\$180 million in loans as of March 1995 to more than 3,500 property owners and renters).

## SPATIAL MATCHES AND MISMATCHES

The spatial distribution of insurance claims, SBA loans, FEMA grants, and HUD loans and grants generally followed the spatial distribution of damaged residential structures (based on OES inspection data). Both the number of insurance claims and SBA loans were strongly correlated with ground-shaking and distance from the fault-rupture projection line, and weakly correlated with area income levels and housing values. Curiously, fewer claims and loans were made in areas with high proportions of homes built before 1950. Average claim, grant, and loan amounts were also correlated with ground-shaking and distance, although less so than the number of claims and loans. Taken together, these various indicators suggest





that most of the public and private rebuilding funds went where they were needed.

There was also a high level of correlation between the spatial distributions of the number and amount of private insurance payouts and SBA loans to homeowners. This would suggest that there were in fact significant overlaps between private insurance payouts and SBA loan funding. By comparison, SBA loans to renters and HUD grants and loans were not correlated with insurance payouts. This would suggest that these programs served a different clientele than did private insurance.

## KEY FINDINGS

Over the years, the term “disaster recovery” has grown to encompass just about every activity that happens in the days, months, and even years after a major natural disaster. In the aftermath of major disasters, government agencies now rush to provide a host of services ranging from temporary shelter, to mental health crisis counseling, to rebuilding assistance through FEMA grants and SBA loans. Thanks to the media, it is this rush to response that occupies our popular attention, as well as the attention of policymakers and planners. Once essential services are restored and people begin returning to their homes, the hardest part of the disaster response and recovery process is often thought to be over. In fact, as the experiences surrounding a number of recent natural disasters show, what is in many ways the hardest part—paying for rebuilding—is just beginning.

As part of this research effort, we reviewed the entire “recovery process” following five recent natural disasters in California, including the Loma Prieta earthquake of 1989, the Oakland hills fire of 1991, the Cape Mendocino earthquakes of 1992, the Landers/Big Bear earthquakes of 1992, and, of course, the Northridge earthquake of 1994. We noted how the process had changed over time, as disaster planners learned from past experiences. We also looked at recurring issues and problems. Among our most significant findings are the following:

**1** *There have been real improvements in the ways federal and state agencies respond to major disasters.*

Most of these improvements have been in the provision of

more and better short-term assistance to a wider spectrum of affected populations. Improvement in the coordination of recovery and rebuilding programs lags behind. Most such programs are still oriented toward single-family homeowners.

**2** *As evidenced in several recent large-scale natural disasters, repairs to private homes typically constitute at least 50% of the cost of recovery.*

Private-sector rebuilding, not the repair of public infrastructure, is by far the costliest aspect of the disaster recovery process.

**3** *The major source of funding for post-disaster rebuilding has been and continues to be private insurance payouts.*

Yet one of the things made most clear in the aftermath of the Northridge earthquake is that private insurers do not have a reliable system for estimating their potential exposure to disaster-based risks. To limit future exposure, private insurers pressured for a greater governmental role, resulting in the creation of the California Earthquake Authority. Although this is a useful first step in restoring the ability of private insurers to underwrite earthquake risk, much more can and should be done to expand the role and effectiveness of private insurance.

**4** *Although well-intended, the current disaster recovery assistance programs administered by FEMA, and particularly by SBA and HUD, are operated in a largely ad hoc and uncoordinated fashion.*

These programs can be made more efficient and cost-effective if reorganized to complement a revitalized system of private insurance.

## RECOMMENDATIONS

The nation’s current system of disaster planning, relief, and recovery has developed through an ad hoc learning process based on experience and a desire to be more responsive to the immediate needs of victims. Overall, the system works well for rural and small disasters, and has improved significantly over time. Agencies such as FEMA at the national level, and OES at the state level, are now much better at coordinating





disaster response and relief efforts than they were seven or eight years ago.

Considerably less has been learned about recovery. Indeed, the nation's disaster management structure remains largely focused on response and relief. Missing is the two-part realization that, at least in the case of large disasters, the recovery phase is both bigger and more complicated than the response/relief phase; and disaster recovery issues typically are much more closely related to the financing of reconstruction than to the reconstruction itself. In the absence of such an understanding, agencies have expanded their individual roles and responsibilities without regard to how well the whole system works. The difficult *financial* aftermaths of Hurricane Andrew in 1992, and the Northridge earthquake in 1994, have pointed to the need for a new conceptualization of public and private rebuilding programs.

We offer four recommendations in this regard:

**1** *That the post-disaster period be seen as consisting of two distinct phases: (a) response and relief; and, (b) recovery and rebuilding.*

The response and relief phase should be dominated by activities that provide immediate shelter, food, and medical care to victims, followed by assistance to stabilize the living conditions of displaced victims. The recovery and rebuilding phase should be dominated by activities that funnel appropriate funds and financing to those whose property has been destroyed or damaged (including local infrastructure). Federal agencies such as FEMA and state agencies such as OES should review their current organizational structure, programs, and services so as to best undertake these two key, and mostly distinct, functions. In addition, in a place like California—where some types of disasters can be planned for—publicly funded rebuilding efforts should give priority to buildings whose owners have undertaken hazards mitigation. This means expanding the scope and level of research into the effectiveness of particular mitigation approaches.

**2** *The primary financial responsibility for funding private post-disaster reconstruction should rest with private insurers.*

Thus, the primary goal of post-disaster public policy should be to increase the utilization of private insurance.

The more private insurers can do to fairly insure individual homeowners, renters, and commercial property owners, the better. We make this argument not out of admiration for the private insurance industry, or because we have been overly impressed with the post-disaster performance of private insurers, but because *only the private insurance industry has access to the volume of capital required to finance post-disaster reconstruction.*

Achieving this goal means substantially increasing the capacity of the private insurance industry to provide appropriate post-disaster reconstruction financing. Improvements in several areas are essential. First, private insurers must be able to more accurately *underwrite* disaster policies and riders. Building on improved underwriting, private insurers must offer consumers a wide choice of policies and products. Just as auto and homeowners' insurance comes in many different product forms, so too should disaster insurance. Giving consumers more product choices will help foster competition, reduce premiums, and encourage more and more homeowners, renters, and commercial property owners to purchase insurance. Ultimately, this will increase the premium pool available for payouts. A critical step in this direction is for the IRS to allow current reserves (against anticipated claims) to be taxed over multiple years.

**3** *Increasing the responsibility and capacity of private insurers will mean decreasing the scope of publicly funded rebuilding programs.*

We believe the role of government policy and programs in post-disaster reconstruction can and should be narrowed into three areas.

- The first role is funding the reconstruction of public infrastructure such as roads, schools, hospitals, government buildings, and selected public utilities. This responsibility currently and appropriately rests with FEMA, the U.S. Department of Transportation and Department of Energy, and a number of other federal agencies.

- The second role is to provide reconstruction funding for victims who, by virtue of low incomes or some form of market failure, cannot afford to purchase private insurance.

One such group comprises low-income renters and





homeowners—those with incomes that are less than 80% of the median area income. To the extent that HUD is involved at all in post-disaster recovery, its role should be limited to providing short-term “gap” grants to low-income renters to help them find market-rate rental housing, and low-interest loans to cash-poor homeowners to help them make repairs.

Owners of multifamily apartment buildings are another such group. Many apartment owners do not carry earthquake insurance for the simple reason that they are unable to recover its cost through higher rents. That is, tenants are unable or unwilling to pay higher rents for units in earthquake-insured buildings. If and when a disaster strikes, the tenants lose their homes and the owner walks away from the property. We believe that one of the primary post-disaster functions of the Small Business Administration should be to provide low-interest loans to these owners.

Conversely, we do not think the SBA should make low-interest loans to middle-income homeowners except for the purpose of covering insurance deductibles. The current system of providing low-interest SBA loans to all homeowners (regardless of income) serves to discourage many homeowners who could afford private insurance from buying it.

In a similar vein, we think FEMA should consolidate and simplify its own separate, small-scale recovery and rebuilding grant and loan programs (including the Minimum Home Repair and Individual Family Grant programs) into one or two income-tested multipurpose grant programs.

- A final role for government is to sponsor and undertake applied research on disaster risk-underwriting. The results of our research indicate it is possible to develop analytic models that predict with reasonable accuracy the likelihood that an individual home will be damaged in a given earthquake, as well as the order of magnitude of the damage. Developing such models requires having access to information on the complete portfolios of multiple insurance companies. Since individual insurers regard such information as proprietary, only an independent public agency can develop such models and disseminate their results. The California

Department of Insurance, the Governor’s Office of Emergency Services, and the California Seismic Safety Commission should jointly establish an independent advisory group whose responsibility it is to develop such models and freely disseminate their results.

The three primary determinants of earthquake damage are the level of ground-shaking, local soil quality, and the ability of the individual building to withstand damage. The U.S. Geological Survey and the California Department of Mines and Geology should cooperate on the further development and dissemination of high-quality, hectare-scale maps and digital databases for use in risk-assessment and underwriting.

Engineers and architects have a reasonably good idea of the general susceptibility of different building technologies (e.g., steel frame, unreinforced masonry, concrete, wood-frame) to earthquake damage. They are less certain of the susceptibility of particular designs. This is particularly true in the case of wood-frame residential structures. The Northridge earthquake caused substantial damage to many wood frame buildings that were thought to be earthquake resistant, while sparing many older homes thought to be more damage-prone. Clearly, there is still much to be learned about the role of particular building designs and construction techniques. The California Seismic Safety Commission, together with the Governor’s Office of Planning and Research and OES, should sponsor and fund such research.

**4** *The best way to reduce the cost of post-disaster rebuilding, particularly post-earthquake rebuilding, is through mitigation.*

Improved mitigation will benefit insurance companies through lower payouts, taxpayers through lower program costs, and, most importantly, renters and homeowners through reduced damage. We have learned three things about earthquake mitigation in the seven years since Loma Prieta: 1) that mitigation works; 2) that the private real estate market in general and the housing market in particular do not reward homeowners who undertake mitigation with higher resale values, or apartment owners who make their buildings safer with higher rents; and 3) that for political reasons the public sector is unable to require appropriate levels of mitigation. Putting these three





lessons together leads to the realization that we must refocus our efforts toward providing financial incentives to promote mitigation. We can think of three such incentives:

- Institute a \$2,000-per-year state income tax credit for homeowners' earthquake mitigation, and a similar \$2,000-per-unit-per year tax deduction for owners of rental property. Tax credits and deductions would carry over from year to year, subject to a total cap (e.g., \$10,000 over 20 years). While such a program would clearly have a negative short-term effect on state revenues, it is likely to be outweighed by its positive impacts. In the short- and medium-run, it would reduce the state's financial exposure through the newly established California Earthquake Authority. In the longer-term, it would serve to reduce the cost of earthquake insurance, as well as make it more attractive for private insurers to offer diverse products. The ultimate benefit, of course, would be improved life-safety and significantly reduced rebuilding costs.

- Require private insurers to offer discounts on earthquake insurance to policyholders who have undertaken significant mitigation.

- Provide incentives to private insurers to train their agents (and underwriters) to conduct earthquake hazard and mitigation inspections, or pay independent inspectors for the same service. To better distribute the costs of training and/or inspection, private insurers should be permitted to write multiyear earthquake policies and riders. Insurers would benefit by having a more stable stream of premiums, and policyholders would benefit by having a multiyear guaranteed premium.

All three of these proposals make sense only to the extent that specific mitigation measures can be shown to be effective. This is an appropriate subject for government-sponsored research.

These recommendations must be considered against

the backdrop of the recently established California Earthquake Authority, about which we have mixed opinions. On the one hand, we view it (or some program like it) as absolutely essential to keeping private insurers active in California. We also think the CEA (through its programs) will encourage more people to purchase some level of earthquake insurance. On the other hand, we worry that the occurrence of a Northridge-scale earthquake in the very near future would exhaust CEA resources, and put additional financial burdens on the state and federal governments (although this would happen with or without a CEA).

*We worry that the California Earthquake Authority will come to be seen as the final step in addressing California's disaster insurance problems—and not as the intermediate step it is. The ultimate goal of the CEA should be to increase the technical and financial capacity of private insurers to generate the broadest range of privately structured products and risk-based funding pools.*

These benefits aside, we worry that the CEA will come to be seen as the final step in addressing California's disaster insurance problems—and not as the intermediate step it is. The ultimate goal of the CEA should be to increase the technical and financial capacity of private insurers to generate the broadest range of privately structured products and risk-based fund pools.

In this sense, the model for the CEA should be the Federal Housing Administration. Established in the 1930s to provide government-underwritten home mortgage insurance, the FHA was also supposed to serve as a demonstration to private insurers of the long-term profitability of insuring homes. As part of its mandate, the FHA developed and published underwriting procedures that could be used by public and private insurers alike to accurately assess insurance risk. Through these innovations, the FHA hoped to reduce the risk associated with mortgage lending, increase the supply of mortgage capital, and ultimately reduce the cost of mortgage insurance. It was successful in all three of these efforts. Today, the FHA is still in business, but its role on the national housing scene is much smaller and more indirect. The primary responsibility for issuing mortgage insurance has devolved to a large, healthy, and competitive private insurance industry.





The great majority of California's population—rich and poor—now lives within 20 miles of a major earthquake fault. Recognizing this reality, many California cities already have or are bolstering their building codes and infrastructure standards in anticipation of a major earthquake. Building codes stipulate minimum life-safety requirements for new construction, and the payoff to improved building codes was evident in the aftermath of both Loma Prieta and Northridge—two major urban earthquakes that killed or injured far fewer people than anticipated. What was greater than anticipated, much greater, was the cost of rebuilding, particularly the cost of residential rebuilding. The federal government stepped in after the Northridge earthquake to assume a significant share of this cost, but there is no guarantee that this will happen next time.

California cannot afford a future in which there are no sources of funding to recover from a major urban earthquake. Even following the best building practices and pursuing a strategy of mitigating hazards in existing buildings, there will be substantial damage in moderate-to-large earthquakes in urban settings. The state must take a stand for more intelligent use of federal funds, for smarter and smaller subsidies to private citizens for recovery, and for encouraging cost-saving mitigation. Even more importantly, California must take the initiative in creating a functioning (mostly private) insurance system by which citizens can protect themselves from hazards and finance repairs in the event of damage.

## NOTES

1. Estimates of the total cost of the Northridge earthquake vary from a low of about \$25 billion, to more than \$35 billion. The low estimate includes losses to public and private property, but not business inventory or economic losses. The latter estimate includes business inventory, lost business, and traveler delay costs.

2. The extent of disaster insurance coverage varies by disaster type as well as location. Fewer than half of California homeowners, for example, carry earthquake insurance. Among homeowners in the Southeast, the proportion with some form of hurricane damage insurance is typically much higher.

3. These concerns are not unfounded. Hurricane Andrew's insured losses were \$16.3 billion and Northridge losses were \$12.5 billion. In both cases approximately two-thirds were residential claims.

4. The OES inspection database includes inspections but no damage estimates for residential structures in Ventura County.

5. The intensity of earthquake damage has traditionally been correlated to distance from the earthquake epicenter. More recently, geologists have begun correlating damage intensity to distance from the surface fault-rupture projection line. This is the intersection of the vertical plane formed by the subsurface fault-rupture with the plane of the ground. In the case of Northridge, this projection took the form of a 15 km east-west line, located just north of the epicenter.

6. Missing from this argument is an acknowledgment that basic homeowners' insurance has been and remains extremely profitable, and that the combination of homeowner and earthquake premiums more than covered total payouts.

7. As of March 1995, private insurance payouts to Northridge policyholders totaled \$6.1 billion. Subsequent payouts have totaled \$2–\$4 billion.

8. Earthquake coverage can be purchased as a stand-alone policy, or as a rider on an existing homeowner, condominium, fire, renter, or mobile-home policy.

*Mary C. Comerio is a professor and vice chairman of the Architecture Department at the University of California at Berkeley, and John D. Landis is an associate professor in the Department of City and Regional Planning. Catherine J. Firpo and Juan Pablo Monzon are graduate research assistants in City and Regional Planning.*

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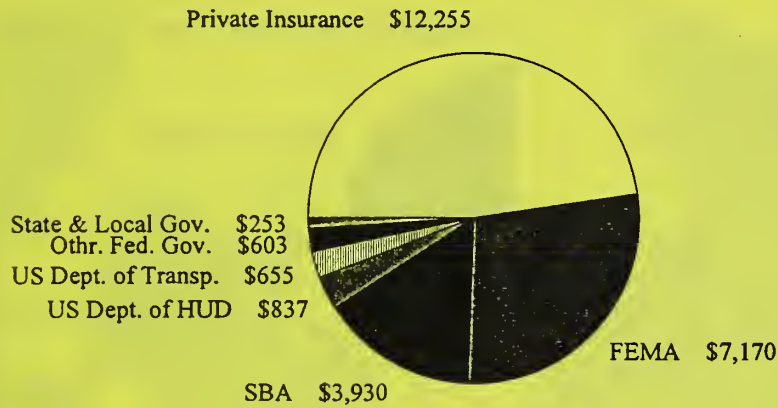
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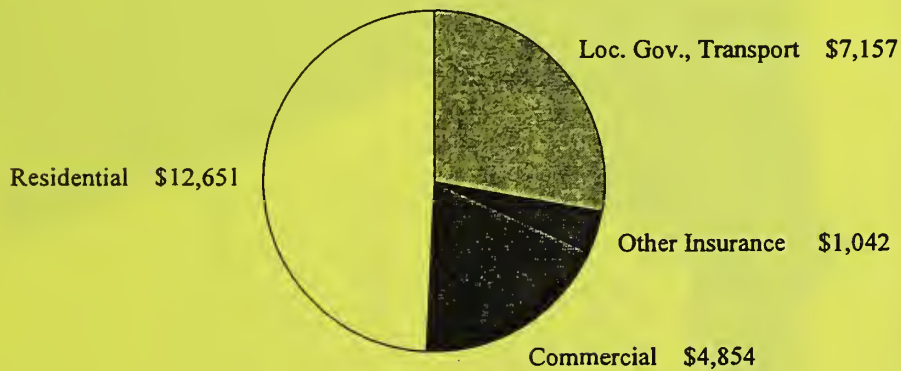
**Figure 6-1: Distribution of Northridge Recovery and Reconstruction Funds by Major Source**



**Funds in Millions  
(Total = \$25.7 Billion)**

Sources: California Department of Insurance, U.S. Office of Management and the Budget, Governor's Office of Emergency Services.

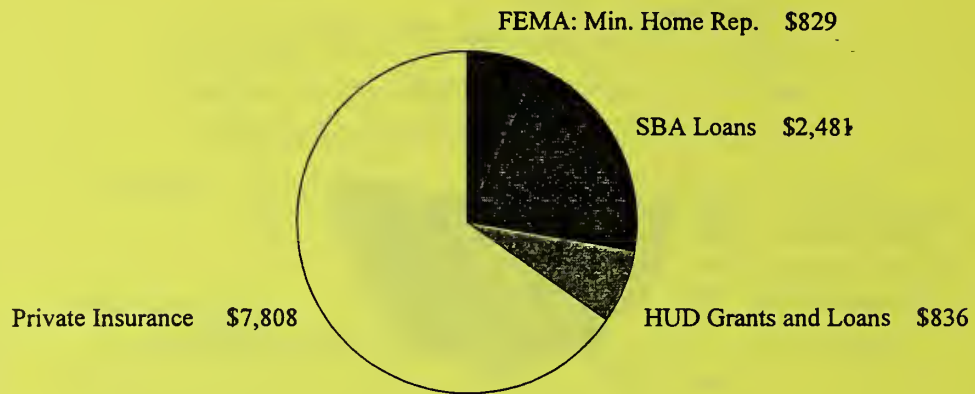
**Figure 6-2: Distribution of Northridge Recovery and Reconstruction Funds by Major Use**



**Funds in Millions  
(Total = \$25.7 Billion)**

Sources: California Department of Insurance, U.S. Office of Management and the Budget, Governor's Office of Emergency Services.

**Figure 6-3: Northridge Residential Reconstruction Funds by Major Source**

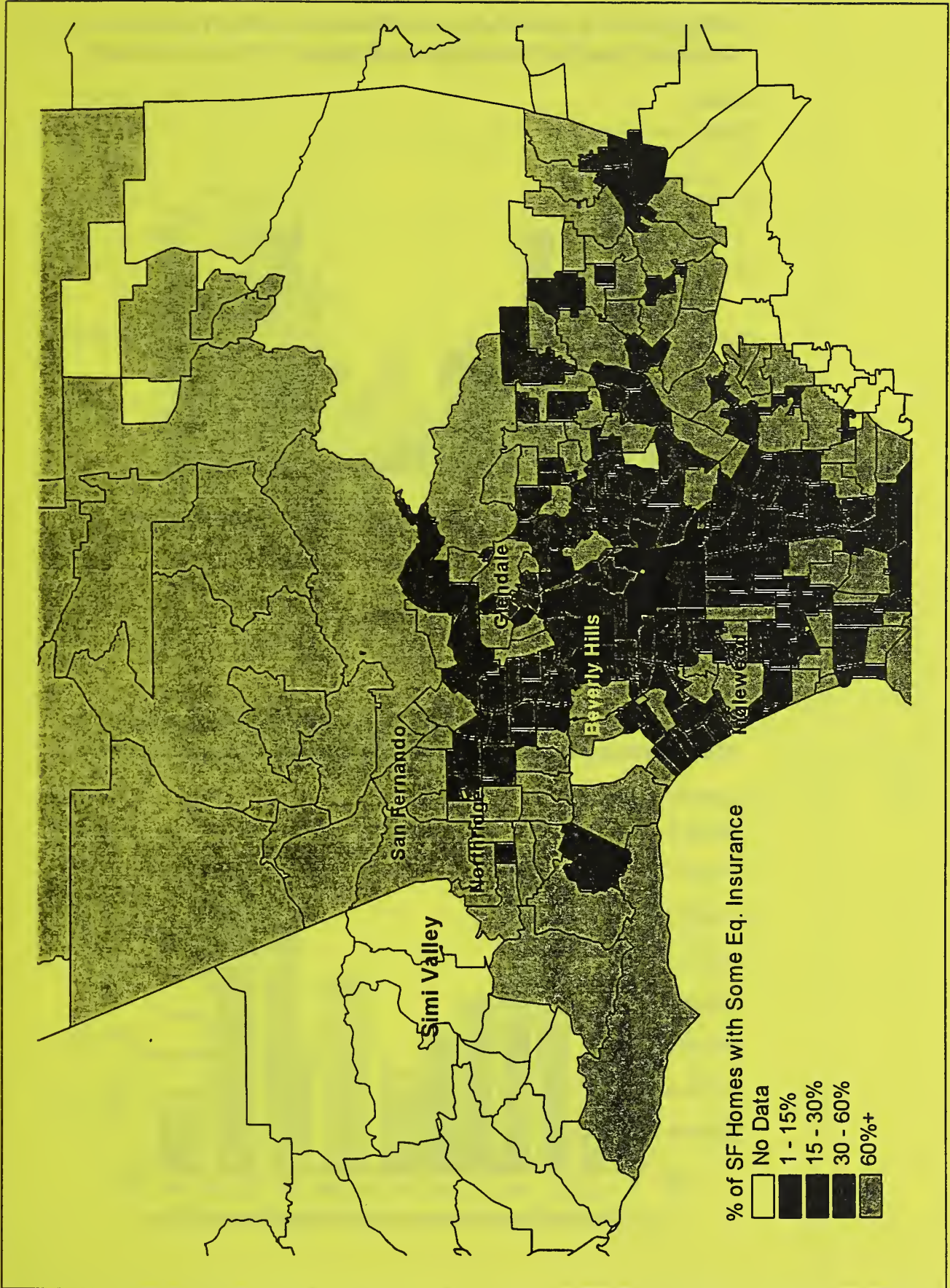


**Funds in Millions  
(Total = \$11.95 Billion)**

Sources: California Department of Insurance, U.S. Office of Management and the Budget,  
Governor's Office of Emergency Services.

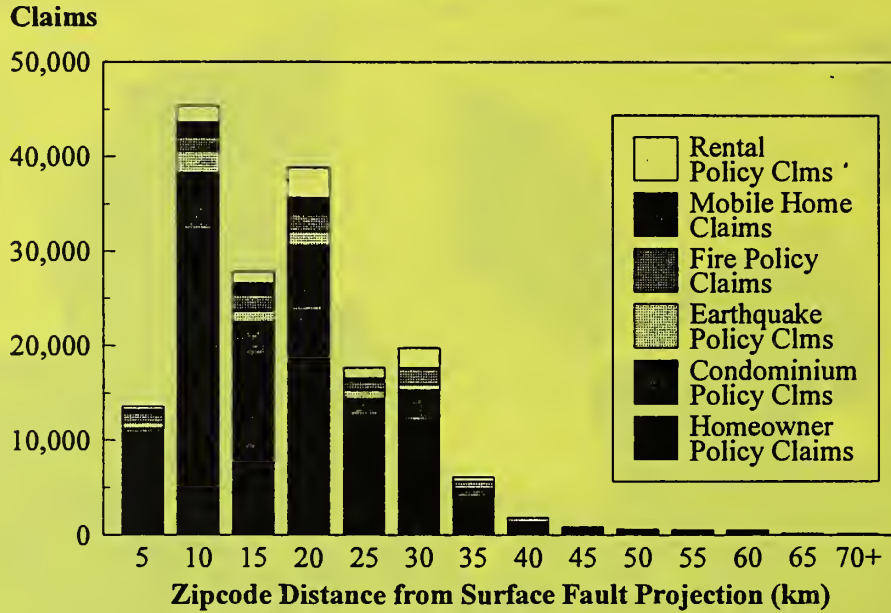


Map 6-1: Share of Single-family Homes with Some Earthquake Insurance Coverage

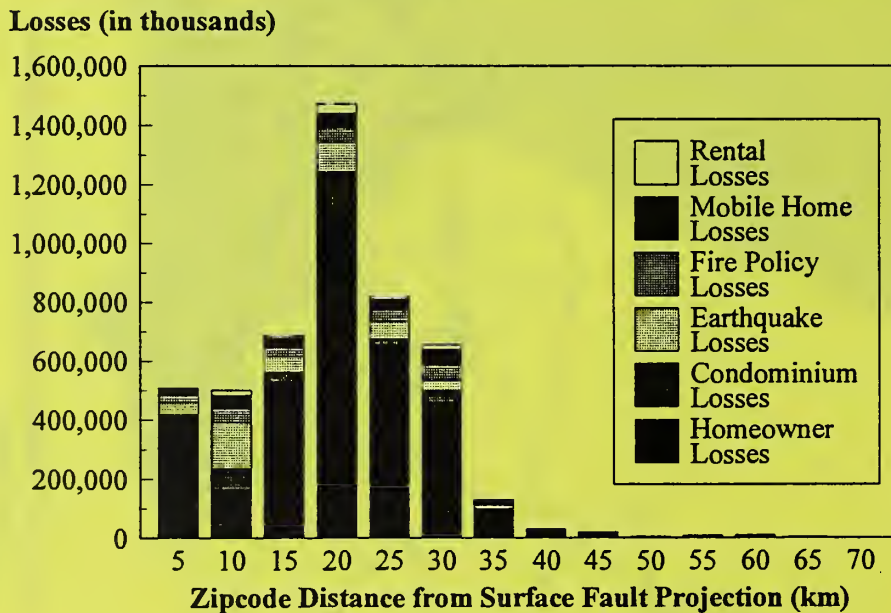




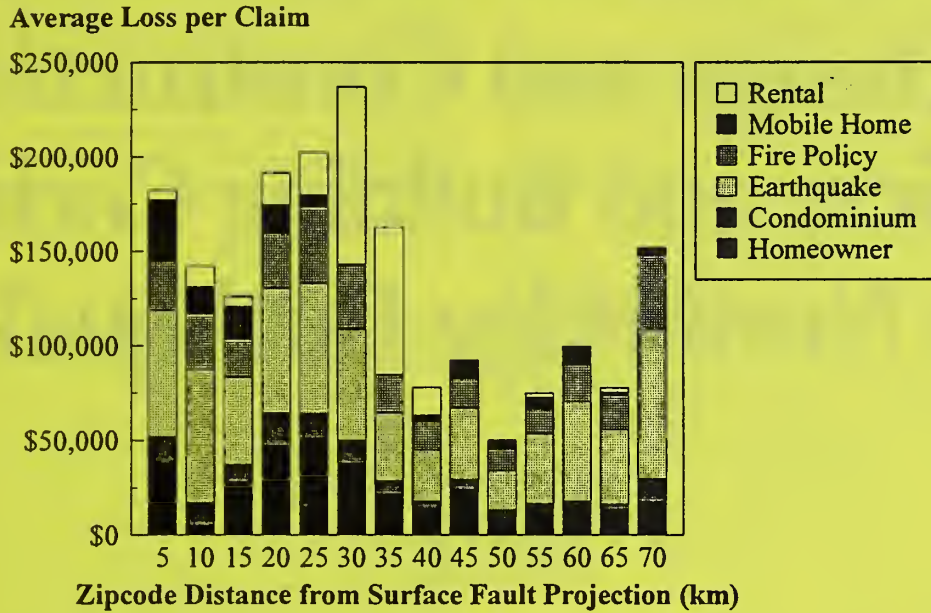
**Figure 6-7: Private Insurance Claims by Policy Type and Distance from the Northridge Fault-Rupture Projection Line**



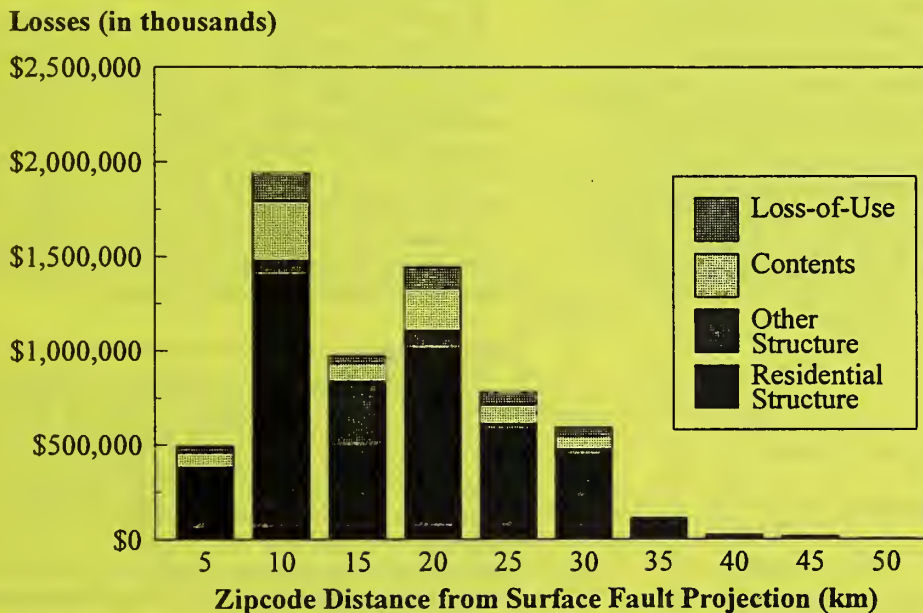
**Figure 6-8: Private Insurance Losses by Policy Type and Distance from the Northridge Fault-Rupture Projection Line**



**Figure 6-9: Private Insurance Average Losses by Policy Type and Distance from the Northridge Fault-Rupture Projection Line**



**Figure 6-10: Private Insurance Losses by Loss Type and Distance from the Northridge Fault-Rupture Projection Line**





# An Overview of the Effectiveness of Design and Construction Practices and Building Codes in the Northridge Earthquake

by Andrew Adelman, P.E.

Chief Building Official  
City of San Jose  
San Jose, California



As chief building official for the City of San Jose, the 11th largest city in the nation, **Andrew Adelman, P.E.**, manages the Building Division's staff of 90 employees and its annual construction valuation of over \$500 million.

Mr. Adelman is currently the chairman/moderator of ICBO's Lateral Design Code Development Committee, which considers proposed revisions to the seismic and wind provisions of the Uniform Building Code™ (U.B.C.). He has been chairman and member of various committees on building codes, inspection and engineering

and is a current member of the Structural Engineers Association of California, the California Building Officials and the American Society of Civil Engineers. A frequent lecturer on building codes and engineering topics at several universities and colleges, Mr. Adelman earned bachelor's degrees in civil and nuclear engineering and a master's degree in structural engineering from the University of California at Berkeley. He is also a registered civil engineer in California, Arizona and Nevada.

## INTRODUCTION

The United States House of Representatives' Science, Space and Technology Committee held hearings entitled "Lessons Learned from Northridge Earthquake" on March 2, 1994, in Washington, D.C. A panel of eight experts in the fields of geology, seismic design, construction and building codes were invited to participate in this congressional hearing. The author was the only building official or local government representative invited to the hearing. This article is adopted from the author's written and verbal testimony during the hearing.

It should be emphasized that the information was presented in early March 1994, less than 45 days after the earthquake. Since then, additional research and investigations have been conducted which have led to new information; however, the key points of the article remain valid. In order to avoid duplication with the presentations of other panelists, the author's testimony focused primarily on administrative, inspection, code and public policy issues regarding the seismic safety of buildings.

The author is currently developing an article detailing the revisions being considered to the U.B.C. seismic provisions for a future issue of *Building Standards* magazine.

## Background

A moderate-to-major earthquake of magnitude 6.7 struck the Northridge area of Los Angeles County at 4:31 a.m. on January 17, 1994. At the date of this hearing, 57 deaths, over 6,000 injuries and over \$20 billion in damage were reported. This earthquake was somewhat unique in three aspects: it generated a higher than usual peak ground acceleration (PGA) at or near its epicenter, the epicenter was located near a densely populated area with a variety of buildings, and it occurred in an area with a great deal of structural engineering and building inspection expertise. Therefore, this unfortunate event presented an excellent opportunity for engineers, architects and building officials to evaluate and learn from the performance of buildings in an earthquake.

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The views expressed here are those of the author and do not necessarily reflect the opinion or agreement of the International Conference of Building Officials.



## History of Seismic Codes in the Western United States

Perhaps by necessity, the west coast, particularly California, has been a leader in the development and implementation of seismic building design regulations. Since the publication of the first edition of the U.B.C. in 1927, there have been steady improvements in seismic codes, often accelerated by significant earthquakes. In particular, significant advances in seismic design requirements were adopted in the U.B.C. following the 1933 Long Beach and 1971 San Fernando earthquakes.

Table 1 provides an overview of the history of seismic codes in the west coast. It is anticipated that the Northridge earthquake will have similar far-reaching effects in the development of seismic codes and design, construction and inspection practices.

## Potential for Substantially Greater Deaths and Injuries

It is important to emphasize that the death and injury toll as a result of the Northridge earthquake could have been much worse if some of the following factors had not limited the damage:

**Time of day.** The earthquake occurred at 4:31 a.m. when the majority of people were sleeping in their wood-frame single-family dwellings, generally considered to be the safest type of building in an earthquake. If the earthquake had occurred in the middle of the day, several hundred people would have been killed at the retail stores and parking garage of the Northridge Fashion Mall alone, where only one person was killed. Also due to the timing of the earthquake, people were not on sidewalks where they could be injured from falling debris, particularly from unreinforced masonry and tilt-up buildings or from falling facades.

**Previous earthquakes.** Many buildings in this area were demolished in previous earthquakes in the region, most recently the 1971 San Fernando and the 1987 Whittier Narrows earthquakes. Therefore, the remaining buildings had either "passed the test" of a previous moderate earthquake or were newer construction.

**Region with long-standing seismic codes.** The region has had the *Uniform Building Code* (or similar building regulations) in effect since the 1920s and 1930s and some level of seismic code in place since the 1930s and 1940s. This substantially contributed to limiting death, injury and damage.

**Recommendation:** *All jurisdictions throughout the United States, or at least all jurisdictions in active seismic zones, should adopt and enforce a nationally recognized building code, such as the U.B.C., which regulates plan approval, permit issuance and construction inspection.*

**Structural engineering expertise.** California in general, and the Los Angeles basin in particular, has benefited from a high level of structural engineering expertise for the design and construction of buildings. This also contributed to limiting death, injury and damage.

**Sound plan check and inspection practices.** Most cities in California have had good building plan review and inspection practices in place for several decades. In particular, the City of Los Angeles Department of Building and Safety has several structural engineers on staff with degrees or licenses. Engineering knowledge and expertise in building inspection departments are critical in ensuring top-quality plan review and inspection for seismic regulations.

**Recommendation:** *All local building inspection departments in active seismic zones should have a registered engineer as part of their staff or management.*

**Retrofitted unreinforced masonry (URM) buildings.** Unreinforced masonry buildings suffer severe damage even in moderate

TABLE 1—HISTORY OF SEISMIC PROVISIONS IN THE WESTERN UNITED STATES

1927	First U.B.C. published Seismic provisions in the U.B.C. appendix (optional to local jurisdictions)
1933	Long Beach earthquake California Field Act—seismic design requirements for schools and, later, hospitals
1940s	Seismic provisions in the main text of U.B.C. (required for all buildings) Prohibited construction of new unreinforced masonry buildings
Late 1940s	Required bolting down of wood-frame buildings (houses, etc.)
Early 1950s	American Society of Civil Engineers/Structural Engineers Association of California (SEAO) Joint Committee published seismic design regulations known as "Separate 66" First consideration of dynamic behavior of structures in earthquake
1959	SEAO State Level Seismology Committee formed 1960 seismic design regulations Ongoing effort for better seismic design codes
1971	San Fernando earthquake—Led to many changes to 1973 and 1976 editions of U.B.C.
1973	New seismic requirements in U.B.C. Wall/roof connection (tilt-up buildings) Soil factor Increased force levels (1.5 to 2.5 times larger than previous code) Ductile (special) moment-resisting frame required for concrete buildings
1985	Mexico City earthquake New seismic requirements in U.B.C. Consideration of resonance due to soft soil
Mid-1980s	California Senate Bill 547—URM Building Retrofit Law
1988	New seismic requirements in U.B.C. Force calculation formula changed Consideration of irregular shape, size and mass Reduced allowable gypsum board shear capacity
1989	Loma Prieta earthquake Amplifications in soft soils larger than anticipated by codes
1991	New edition of U.B.C. More stringent requirements for buildings on soft soil URM retrofit standards (U.C.B.C Appendix Chapter 1)
1994	New edition of U.B.C. Use of conventional wood-frame construction was defined and limited Northridge earthquake Potential new changes to seismic codes



earthquakes. Fortunately, the City of Los Angeles has had a mandatory URM retrofit program in place since the early 1980s, resulting in retrofits before the earthquake to approximately 6,000 of the 8,000 URM buildings in Los Angeles. Potential deaths, injuries and damage to the most susceptible type of building had been substantially mitigated prior to the earthquake.

**Recommendation:** *Jurisdictions in active seismic zones should mandate a URM seismic retrofit program requiring compliance to Uniform Code for Building Conservation™ (U.C.B.C.) Appendix Chapter 1 as minimum acceptable criteria.*

## OVERVIEW OF PERFORMANCE OF BUILDINGS IN NORTHRIDGE EARTHQUAKE

With some exceptions, the buildings performed as well as could have been expected considering the earthquake's high horizontal and vertical peak ground acceleration at and near the epicenter. The major exceptions were damage to steel structures, particularly welded rigid moment-resisting connections, and concrete parking structures (specifically the complete collapse of the California State University at Northridge parking structure, constructed around 1990). These unexpected failures have been the subject of substantial structural engineering evaluation, research and debate since the earthquake. The following is a brief overview of the performance of some building types during the earthquake.

### Steel Buildings

Although there were no collapses of any steel buildings, several such buildings suffered damage. This was somewhat unexpected as properly designed and built steel buildings have been known to perform well in earthquakes. The pattern of damage was generally failure of connections (particularly welded moment-resisting connections such as girder-to-column connections), buckled bracing and member buckling in braced-frame buildings. The unexpected repeated pattern of damage to welded moment connections is a major source of concern and has led to substantial investigation and research. Although some potential contributing factors have been identified, the final findings and potential code changes for connections and moment-resisting steel frame buildings are not yet known.

### Reinforced Concrete Buildings

**Tilt-up.** Modern (post-1973 to 1976) and retrofitted tilt-up buildings suffered some unexpected damage, indicating the need for re-evaluation of certain elements and force levels of these buildings. As expected, pre-1973 to 1976 tilt-up buildings suffered considerable damage, particularly at the roof/wall connections, resulting in separation or falling out of the tilt-up walls. It should be noted that the City of Los Angeles passed a mandatory pre-1976 tilt-up retrofit ordinance shortly after the Northridge earthquake.

**Cast-in-place concrete.** Modern (post-1976) concrete buildings performed adequately. Pre-1976 concrete buildings suffered damage, particularly when their elastic limit was exceeded as expected. Some concrete buildings with a waffle slab-column system (such as in the Bullocks Department Store at the Northridge Fashion Center) suffered punching shear failure as a result of direct shear and torsion, leading to collapse.

**Precast.** Several precast concrete parking garages suffered severe damage and collapse due to failure of connections, inadequate load path and lack of compatibility of design. A particular surprise was severe damage or even complete collapse of some recently constructed buildings, such as the parking structure at

Cal State Northridge, indicating the need for detailed investigations of failures in this type of building.

### Wood-frame Buildings

**Single-family dwellings.** One- and two-story wood-frame single-family dwellings suffered limited damage, such as cracks in stucco and sheet rock and toppled masonry chimneys. It should be noted that following the earthquake the City of Los Angeles limited the construction of new masonry chimneys to avoid future repeated brick chimney failures.

**Apartment buildings.** Several multistory wood-frame apartment buildings suffered major damage, resulting in several deaths. Although the most drastic failure was at the Northridge Meadows Apartments in Northridge, where 16 people died, many other apartment buildings suffered a similar pattern of failure, to varying degrees. Both old and new two- or three-story apartment buildings with large openings in the lower floor (soft story) consisting of parking garages or patio doors generally performed poorly. In the direction parallel to large openings, inadequate narrow plywood shear walls failed at boundary nailing and hold downs. In the direction perpendicular to large openings, the gypsum board and stucco were supposed to act as shear walls but failed by buckling and pulling away from the structural wood frame. The lower levels, which were supported on slender steel columns, failed due to the weight of the buildings (inverse pendulum effect) and the vertical component of the earthquake added to the bending created as a result of deflection ( $P\Delta$  effect) due to the horizontal component of the earthquake.

Many of the apartment building collapses in Northridge had an uncanny resemblance to those in the Marina District of San Francisco, California, following the 1989 Loma Prieta earthquake, not only in human tragedy, but also in the mode of failure of the structures. Wood-frame apartment building collapses in these two earthquakes mandate that we take their design more seriously. A discussion on conventional wood-frame construction appears later in this article.

**Recommendation:** *Clarify and limit the use of conventional wood-frame construction without engineering analysis and design for one- and two-story single-family dwellings and one-story multifamily dwellings.*

### Masonry Buildings

**Modern masonry buildings.** Masonry buildings with modern engineering performed similar to tilt-up and cast-in-place concrete buildings.

**Retrofitted URM buildings.** As previously discussed, approximately 6,000 of 8,000 URM buildings in Los Angeles had been retrofitted prior to the Northridge earthquake. Retrofitted URM buildings performed much better than nonretrofitted URM buildings. Although some retrofitted URM buildings suffered damage, there were no deaths attributed to retrofitted URM buildings, an indication that retrofitting URM buildings reduces the threat to life safety. Less than 1 percent of retrofitted URM buildings (approximately 50 out of 6,000) were damaged to the extent that they had to be demolished. However, it should be noted that most of the retrofitted URM buildings are located in Santa Monica, Hollywood and Pasadena, all of which are more than 10 miles from the earthquake's epicenter. Therefore, the question of how well a retrofitted URM building performs in a major earthquake in its immediate vicinity remains unanswered.

**Nonretrofitted URM buildings.** As expected, nonretrofitted URM buildings performed very poorly. Particularly, nonretrofitted URM wall parapets collapsed and fell into the side walls. The town of Fillmore in Ventura County, which is about 20 miles from the epicenter, had a much higher rate of damage to its URM



buildings because they were not retrofitted, compared to Santa Monica and Hollywood which were closer to the epicenter but had retrofitted URM buildings.

This clearly demonstrates that retrofitting URM buildings reduces damage to buildings and therefore limits the life-safety threat to occupants and passers-by.

**Recommendation:** *Jurisdictions in active seismic zones should mandate a URM seismic retrofit program requiring compliance to U.C.B.C. Appendix Chapter 1 as minimum acceptable criteria.*

#### FACTORS IN BUILDING SAFETY— BUILDING DESIGN AND CONSTRUCTION

Proper design and construction practices greatly contribute to safe buildings. This is particularly true in the seismic design and construction of major buildings. There are several design and construction issues which directly impact the safety of buildings during earthquakes.

##### Architectural Configuration

The configuration of a building directly affects its performance during an earthquake. Unusual shapes, configurations and large open levels in buildings contribute to poor building performance during a seismic event. Unfortunately, architectural configurations of buildings are at times selected before consulting the structural engineer, who is expected to design the building to withstand earthquake forces. When the structural engineer joins the design team, he or she is in the difficult position of trying to force configuration changes at the risk of losing the project, or settling for a less-than-desirable seismic design mandated by a preplanned building configuration. This form-over-safety mentality of clients sometimes leads to less-than-desirable building configuration regarding seismic safety.

##### Engineering Design Fees

Typically, engineering design fees are set at 1 to 1 3/4 percent of the cost of construction, which is only a fraction of the architectural design fee of 8 to 10 percent. In many cases, this limits the ability of the engineer to perform full engineering analysis and design while remaining within the limits of the structural engineering fees.

##### Piecemeal Engineering versus Engineer of Record

On many occasions, different elements of the buildings are designed by different engineering companies without full coordination of their compatibility by a single engineer of record. For example, it is typical that the underground concrete parking structure for a three-story apartment building is designed by one engineering firm, the wood-frame building is designed by a second engineering firm, and the roof and floor trusses are designed by yet a third engineering firm. None of the firms are paid to take full responsibility for coordinating the overall safety of the building and the compatibility of the building components. This creates problems with load path, connection detail and overall compatibility. This problem most likely contributed to the failures of some of the precast concrete parking structures in the Northridge earthquake.

**Recommendation:** *Require that one engineer be designated as the engineer of record for each building and be responsible for the overall design and compatibility of the building.*

##### Economy of Building Design

In order to build the most economical buildings, we have

reduced materials and redundancy in structural systems by using more advanced structural engineering techniques. This requires more-detailed, better-coordinated engineering analysis and design. However, as previously discussed, severe limitations in engineering fees do not allow engineers to perform the additional structural engineering analysis and design required to compensate for reduced materials and redundancy in building systems.

##### Lowest Bidder

Most major buildings get built by the "low bidder" after a competitive bidding process. A contractor can often make a low bid by complying with only the minimum specification and design requirements. In addition to other design issues, this factor leads to construction of marginally safe buildings, particularly in active seismic zones.

##### Education and Training

Building codes and structural engineering principles are only as effective as their proper implementation in actual design and construction. The building codes are updated and new engineering requirements are added every three years. There is a need for continuous education and training of architects, engineers and contractors in new aspects of codes and engineering, particularly in active seismic regions.

#### FACTORS IN BUILDING SAFETY— BUILDING INSPECTION DEPARTMENTS

The function of local building inspection departments is to protect the lives and safety of the public through plan review, permit issuance, and inspection of buildings in accordance with codes and engineering regulations. Considering the reasons previously discussed, local building inspection departments often become the "last line of defense" for constructing safe buildings. However, building inspection departments face many challenges in performing their duties adequately. The following are some issues to consider in the performance of duties of local building inspection departments.

##### Volume of Work

Local building inspection departments typically face extremely high demand for their services considering their available resources. This demand directly affects the quality of plan review and inspection of buildings. For example, the City of San Jose, with a population of over 800,000, is the eleventh largest city in the nation. San Jose's building inspection division has a staff of approximately 90 employees, of which approximately 45 are inspectors and 10 are engineers. Each year, this staff issues 23,000 permits (one permit every five working minutes), reviews over 5,000 plans and performs over 150,000 inspections (one inspection every 45 working seconds). This volume of work hardly allows much time for ensuring high quality construction and creates an undue burden on local building inspection departments for ensuring the public's life safety.

##### Budget and Staffing

Local building inspection departments collect fees for providing their services. However, these fees are often deposited into the local jurisdiction's general fund. At the time of the budget process, the local building inspection function must compete with other services such as police, fire and libraries for very limited general fund resources. The building inspection functions sometimes have to work hard to be allowed to use the fees they have earned for performing their functions.

*(continued)*



This problem becomes even more critical when considering the cyclical nature of construction and the economy. During the heavy construction periods, the surplus revenue generated by the building inspection functions are rolled over to the general fund and used for other purposes. During the slow construction periods, staffing for building inspection functions is reduced commensurate with the lower activity levels and revenue. This pattern reduces the ability of the local building inspection functions to provide high quality plan review and inspection.

**Recommendation:** *Permit fees collected by local building inspection departments should be used for staffing and activities directly related to building inspection functions. Any surplus revenue should be placed in a special account to be used during low revenue periods.*

### Economic Development Pressures

Building construction is an important economic development activity. Before new companies and new jobs can move into a region, structures must be built to house them. Due to lingering recessions in many regions, there is a great deal of competition among cities and regions to attract businesses and new jobs. Building inspection departments, as part of the overall local government, must play their role in facilitating a region's economic development. Therefore, building inspection departments are sometimes pressured into permitting and approving construction projects which may require more careful review and inspection.

### Education and Training

The Building Code and some of its structural engineering requirements change every three years. It is necessary to provide continuous education and training for building inspection department staff to ensure proper implementation of codes, particularly for the complicated seismic provisions.

**Recommendation:** *Designate 1 percent of local building inspection department revenues to be dedicated to education and training of staff.*

### Engineering Expertise

The engineering and technical expertise of building inspection departments is critical in ensuring high quality plan review and inspection for seismic requirements. This takes on even more importance in view of the design and construction issues previously discussed and the fact that local building departments often become the last line of defense in the construction of safe buildings.

**Recommendation:** *All local building inspection departments in active seismic zones should have a registered engineer as a part of their staff or management.*

### Enforcement of Miscellaneous Regulations

Local building inspection departments are often burdened with enforcement of numerous (and ever-increasing) miscellaneous regulations. Added to a department's already busy workload, these regulations reduce the ability to focus on life-safety issues. Many of these miscellaneous regulations are mandated by state or regional agencies and the burden of enforcement is placed on local building inspection departments.

The following is a partial list of regulations being enforced by a local building inspection department in northern California: Uniform Building, Plumbing, Mechanical and Fire Codes; *National Electrical Code*<sup>®</sup>; structural regulations; California energy conser-

vation and disabled access regulations; other miscellaneous California revisions to the codes; worker's compensation; contractor's licensing; Bay Area Air Quality Management District; local health department regulations; and local zoning regulations.

**Recommendation:** *Streamline and limit miscellaneous regulations being mandated by state and regional agencies for enforcement by local building inspection departments to allow more emphasis on the life-safety aspects of buildings.*

## PROPER SEISMIC DESIGN OF NEW CONSTRUCTION VERSUS RETROFITTING

It is far less expensive to design and build new buildings in accordance with proper seismic regulations than to try to retrofit at a later date. It is estimated that proper seismic design and construction of new buildings adds only 1 to 3 percent to the total cost of the building, while seismic retrofitting of existing buildings costs between 20 to 50 percent of the value of the building, depending on the building's structural system and condition. As a matter of public policy, it is therefore extremely cost effective to mandate proper initial design rather than requiring retrofitting at a later date.

**Recommendation:** *Local jurisdictions should enforce the appropriate latest seismic provisions, such as those contained in the U.B.C., for all new buildings.*

## SEISMIC PROVISIONS—LIFE SAFETY VERSUS PROPERTY PROTECTION

The primary purpose of the *Uniform Building Code* seismic provisions is the protection of the life safety of building occupants and passers-by. In simple language, the primary intent of the code is for people to walk out of a building after an earthquake without major injuries, even though the building may have suffered damage beyond repair. In recent years, certain provisions (such as deflection control, drift limit, etc.) have been added to the building codes which provide some measure of damage control; however, the primary purpose of building codes remains life safety. Although the public perception may be that the goal of building codes is to create "earthquake-proof" buildings, there is no such thing. The best we can strive for is "earthquake-resistant" buildings.

Current building code provisions are based on minimum life-safety standards for all buildings. Careful consideration of costs and benefits is needed before changing the goal of the codes to property protection. Such a change would be a major new public policy direction for building codes. Of course, even under the current codes, owners, architects and engineers have the option of choosing a more stringent level of seismic safety to provide enhanced protection for their property.

## SEISMIC DESIGN RESEARCH

Continued seismic research, particularly structural engineering research, for construction of new buildings and retrofitting of existing hazardous buildings is needed to develop and test new techniques for better safety. It is important that the research results be put in simple, easy-to-implement provisions; the research should be overseen by a panel of structural engineering practitioners and building officials to ensure its applicability to real-life buildings and problems. It is somewhat ironic that the National Center for Earthquake Engineering is located in Buffalo, New York, far from the highest level of seismic activity and expertise in this country. Such research must be conducted in



areas with awareness and expertise in seismic design issues with input from a wide range of technical experts.

### Potential Changes in Seismic Provisions

The Northridge earthquake provided a unique real-life laboratory for structural engineers and building officials to evaluate the performance of a wide variety of buildings. The following are some of the changes to the U.B.C. seismic provisions which will be considered during the upcoming months:

**Limit use of conventional wood-frame construction.** Conventional wood-frame construction provisions (also called "deemed-to-comply" in some regions) are a cookbook approach which allows contractors to build simple, small, box-shaped residential buildings without requiring structural engineering analysis or design. Over the years, the configurations and types of buildings being constructed have substantially changed. Most houses currently being constructed contain large windows, vaulted ceilings, two- or three-car garages on small lots, etc., which challenge the safe limits of conventional construction. Most current apartment buildings are multistory with large openings in the lower level in the form of garages or patio doors and require detailed structural engineering calculations.

Unfortunately, conventional framing is still being used well beyond its safe limits for large, complicated hillside homes with large openings and multistory apartment buildings. Many building officials question the use of conventional framing for buildings which normally would require structural engineering calculations, but they are forced to accept conventional framing because the building codes allow its use. Fortunately, the 1994 U.B.C. has somewhat clarified the limits of use of conventional framing. However, the repeated failures and loss of life from the Loma Prieta and Northridge earthquakes clearly demonstrate the hazard of improperly designed multistory wood-frame apartment buildings. The use of conventional framing must therefore be limited to buildings which can be clearly demonstrated to be within the safe limits for this type of construction.

**Recommendation:** Clarify and limit the use of conventional wood-frame construction without engineering analysis and design to one- and two-story single-family dwellings and one-story multifamily dwellings.

**Substantially limit the use of gypsum board as shear wall.** Gypsum board is a brittle material not suitable for resisting cyclical loading from earthquakes. Gypsum shear walls performed very poorly in the Northridge earthquake, buckling and pulling away from their attachments.

**Recommendation:** Eliminate the use of gypsum board as a shear material in active seismic zones except for one-story conventional framing for single-family dwellings.

**Limit the use of stucco as shear wall.** Stucco shear walls failed in the Northridge earthquake by buckling and pulling out of staples that lacked adequate penetration into wood-framing members.

**Recommendation:** Limit the use of stucco shear walls in active seismic zones to one-story buildings or the top story of multi-story buildings.

**Consider creating a new (near-fault) Seismic Zone 5.** The Uniform Building Code currently contains Seismic Zones 0, 1, 2A, 2B, 3 and 4. Seismic Zone 0 represents regions with little or no seismic hazard and Seismic Zone 4 represents the regions with the most active seismic conditions. However, there is no zone or criteria for areas in immediate vicinity of active faults. The results of the Northridge earthquake, even though moderate in magnitude, may point to the need for a new near-fault seismic zone.

The maximum horizontal peak ground acceleration used in U.B.C. seismic calculations for Seismic Zone 4 is 0.4g. The horizontal PGA during the Northridge earthquake was 1.82g at one location and 0.9g in several other locations. Even dismissing the one location with the highest PGA as special local conditions, the horizontal ground acceleration exceeded the most stringent requirements of the U.B.C. by a factor of 2.5. Similarly, the maximum actual vertical PGA at one location was 1.18g and in several other locations was 0.6g, substantially exceeding the most stringent requirements of the U.B.C. This may indicate the need for considering a new near-fault seismic zone for earthquakes with forces of 1.5 to 2.0 times stronger than current Seismic Zone 4 and to reflect more stringent seismic design and detailing requirements.

The development of a new Seismic Zone 5, using seismic hazard maps developed by the National Earthquake Hazards Reduction Program (NEHRP) and the United States Geological Survey (USGS), may be the best available compromise between building code practitioners and USGS seismologists. This new seismic zone incorporates some of the latest scientific information from USGS which indicates the potential for much higher peak ground acceleration near major faults than the acceleration used in the U.B.C. Use of the new seismic zone will also allow engineers and building officials to continue using the current practical code approach of a limited number of seismic zones rather than the proposed, complicated NEHRP methodology with hundreds of micro-seismic zones.

**Recommendation:** Consider developing a new, near-fault Seismic Zone 5 in the U.B.C. for areas in the immediate vicinity of active faults with forces 1.5 to 2.0 times stronger than the current Seismic Zone 4, and more stringent seismic design and detailing requirements.

**Consideration of vertical component of earthquakes.** Several buildings may have failed as a result of their weight and the vertical components of the earthquake combined with the horizontal effects. This may have been a major factor in the failure of the wood-frame Northridge Meadows Apartments and some of the concrete parking structures.

**Recommendation:** Re-evaluate consideration of the vertical component of earthquakes in seismic design.

**Consider reducing the numerical coefficient,  $R_w$ , for inverted pendulums (an apartment building above a slender steel column) to increase the design lateral forces.** Apartment buildings constructed above wide-open (soft story) garages and supported by slender steel columns, such as the Northridge Meadows Apartments, performed very poorly. This structural system may need to be designed for more stringent structural engineering criteria.

**Recommendation:** Consider decreasing the numerical coefficient,  $R_w$ , or other modifications for inverted pendulum-type buildings to increase structural design requirements for such buildings.

### CONCLUSION

Upon evaluation of the impact of the Northridge earthquake in comparison to the estimate of hazard of similar earthquakes in different regions, it is clear that the degree of death, injury and damage could have been substantially higher. Adherence to the recommendations in this article could go a long way toward ensuring that future earthquakes further limit the risk to life safety. ■







**MEMORANDUM**

**Date:** October 24, 1996

**To:** Honorable Byron Sher, Chairman  
Senate Committee on Housing and Land Use  
Attn: Peter Detwiler, Committee Consultant

**From:** Dan C. Dunmoyer, President  
Phyllis A. Marshall, Senior Legislative Counsel  
Diane Colborn, Senior Legislative Advocate *DC*

**Subject:** October 16, 1996 Interim Hearing on: "An Ounce of Prevention:  
Planning and Regulating for Seismic Hazards"

Thank you for the opportunity to testify and to submit written comments on the insurance industry's consideration of earthquake hazard mitigation. The Personal Insurance Federation of California (PIFC) represents insurers selling approximately 40% of the homeowners & earthquake insurance sold in California. The following comments provide a brief overview of the effect of earthquake retrofitting on insurance eligibility and rates. Since we expect much of the earthquake insurance written in California in the future to be written through the California Earthquake Authority (CEA), we have focused first on how earthquake retrofitting is addressed in the CEA.

**CALIFORNIA EARTHQUAKE AUTHORITY**

**Coverage Provided by the CEA**

The CEA is a privately funded, publicly run entity that will provide basic earthquake coverage for homeowners in California. Companies who choose to participate in the CEA are required to transfer all of their existing earthquake business to the CEA, and to offer the CEA coverage to all new policyholders they insure for homeowners coverage. Homeowners are eligible for CEA coverage if their homeowners insurance policy is provided by a CEA participating carrier. The CEA will also provide renters coverage and condominium loss assessment coverage. The Insurance Commissioner has set of goal of December 1, 1996 for the CEA to become operational. In order for the CEA to become operational, insurers representing 70% of the residential homeowners insurance market in California must agree to participate and to pay their share of the initial capital investment.

The CEA policy will be essentially the same as the "mini-policy" [AB 1366 (Knowles) of 1995] and will cover structural damages in an amount up to the value insured under the homeowners policy, coverage A. It will also provide \$5,000 in contents coverage and



\$1,500 in additional living expenses. The additional living expense will increase in future years to \$2,500 and \$3,000 if the CEA fund builds to certain specified levels. The required deductible on the policy is 15%.

The CEA policy is intended to cover catastrophic losses and repairs necessary to restore the basic habitability of the structure. Therefore, it does not cover outbuildings, appurtenant structures, patios, swimming pools, or other damages not essential to the structural integrity of the dwelling. Insurers will be able to meet the mandate to offer earthquake coverage by offering policyholders a CEA policy. The CEA is intended to ensure that at least a bare bones basic earthquake policy is available, so that a homeowner does not risk losing everything in the case of a major quake. Insurers may choose to offer additional wrap-around coverage to supplement the CEA coverage. We believe that if there is sufficient demand for additional coverages that the market will respond in time, and some insurance companies will come forward to address that need.

### How the CEA Addresses Retrofitting

The CEA includes the following provision regarding earthquake retrofitting:

“Policyholders who have retrofitted their homes to withstand earthquake shake damage according to standards and to the extent set by the board shall enjoy a premium discount or credit of not less than 5% on the authority-issued policy of residential earthquake coverage, as long as the discount or credit is determined actuarially sound by the authority.” (Insurance Code Section 10089.40(d).)

It should be noted that this provision gives the CEA Governing Board the authority to approve a larger discount or credit, as long as the credit is determined by the authority to be actuarially sound. In fact, there is no cap on the amount of discount or credit which may be approved by the board. Retrofitting is a factor primarily for homes built prior to 1960, as discussed further below. The CEA rating plan adopted by the CEA Governing Board in October and submitted to the Insurance Commissioner for approval provides for a discount of 5% if the home was built prior to 1960, the dwelling is tied to the foundation, cripple walls are braced with plywood or its equivalent, and the hot water heater is secured to the building frame. (See attached pages from CEA rate manual.)

The rates for CEA coverage are also subject to the requirements of Proposition 103, which include that the rates must not be excessive, inadequate or unfairly discriminatory. In addition, the rates are subject to Proposition 103’s public hearing process and intervenor requirements.

In addition to the above referenced provision on retrofitting credits, whether or not a home has been retrofitted is to a certain extent reflected in the rating structure of the CEA, which provides for differentials in rates based on the age of the dwelling and the type of construction. The CEA requires, among other things, that rates shall be established based on the best available scientific information for assessing the risk of earthquake frequency, severity, and loss, and that equivalent rates shall be charged for equivalent risks. [See AB 3232 (Knowles) of 1996.] Factors the Governing Board must consider in adopting rates include the location of the insured property and its proximity to earthquake faults and other geological factors that affect the earthquake risk, soil type, construction type and features of the insured dwelling, age of the dwelling, and the presence of earthquake hazard



reduction factors, including tying or bracing the structure to the foundation, reinforcement of the fireplace chimney, and securing of the water heater.

At the CEA Governing Board hearing in September, the CEA actuary who advised the board on the development of the rating plan, and the earthquake modeling company which was selected to simulate the expected losses, testified regarding the detailed process that was followed in developing the rating plan. The process involved analysis of seismic hazards utilizing the most current geological and seismological data, seismic zoning maps, engineering studies, and detailed analysis of exposure risk. The work was peer reviewed by Jim Davis, California State Geologist and Chief of the California Division of Mines and Geology, and by Professor Tom Heney, Professor of Geological Science at UCLA and Executive Director of the Southern California Earthquake Center.

According to the testimony at the Governing Board hearing, the rates will differ significantly not only by location but also by age and type of construction. Retrofitting is an issue primarily for older homes built prior to 1960. The age categories in the CEA rating plan correspond to changes in building code requirements. For example, older homes built prior to 1960 will see rates which are on average 9% higher than the territorial average unless the home is retrofitted. After 1960, changes in building codes generally required anchor bolting and the need for bracing was reduced due to advances in construction design. Homes built between 1960 and 1978 will have rates on average 4% higher than the territorial average. Rates for homes built after 1978 will be on average 15% lower than the territorial average. As stated above, homes built prior to 1960 will be eligible for the 5% discount if retrofitted as specified.

According to the testimony provided at the CEA Governing Board hearing, the type of construction is also a factor, although this affects a smaller number of homes since it is estimated that 99% of the homes insured through the CEA will be of frame construction. The small percentage of homes which are of masonry construction, however, may face rates as much as 50% higher than the territorial average.

### Insurers Outside of CEA

Since participation in the CEA is voluntary, a number of companies will choose not to participate in the CEA and will continue to offer earthquake insurance on their own. Insurance companies generally consider construction standards when determining eligibility of a particular property for insurance coverage. In some cases, whether or not the structure has been retrofitted for earthquake is reflected in the premium charged. Because insurance is a competitive business, the criteria and standards applied are not uniform for all companies, giving consumers the choice to shop around and obtain the coverage that best suits their individual needs.

Most insurers provide incentives for property owners to retrofit their homes in the form of eligibility guidelines. For example, most companies will not insure properties built prior to 1960, for earthquake or homeowners coverage, unless they are retrofitted with anchor bolts, cripple wall bracing, and strapped water heaters. After 1960, the building code standards improved significantly so that bracing was no longer as critical due to advances in construction design, and in most cases anchor bolting was required as a code feature. Recent legislation [SB 304 (Rosenthal) of 1995 and SB 577 (Rosenthal) of 1996] also requires strapping of water heaters on both newly constructed and previously built homes.



### Statutory Requirements

Several incentives for property owners to retrofit are also provided by statute. Current law, Insurance Code Section 10082.5, provides that if an insurer charges an additional earthquake insurance premium or deductible because a dwelling fails to comply with anchor bolt, cripple wall bracing, or water heater strapping requirements, and the dwelling is subsequently brought into compliance, then the additional premium or deductible attributed to noncompliance may not be charged.

Insurance Code Section 10089.15 requires insurers to offer building code upgrade coverage in the amount of \$10,000 only after the insured has completed and the insurer has verified retrofitting of the residential dwelling.

Finally, Insurance Code Section 10089.2 requires insurers to disclose to each applicant in writing as a freestanding document any discounts and surcharges available from the insurer for retrofitting, including tying or bracing the structure to the foundation, reinforcement of the fireplace chimney, and securing of the water heater.

### Inspections

Insurance companies have different policies regarding home inspections. Many companies require an on-sight inspection before issuing a policy. One of our larger company members has instituted a reinspection program, which requires an initial inspection and a reinspection of every home insured at least once over a five-year period. Upon reinspection, if a home is found to be in serious violation of building code safety requirements, the property owner will generally be required to correct the deficiency within a specified period of time or the policy may be subject to cancellation or nonrenewal.

The CEA Governing Board's policy regarding inspections is currently under review. A subcommittee of the Advisory Committee was formed at the October meeting to develop recommendations to the Governing Board regarding the frequency and scope of inspections to be required. The subcommittee plans to report those recommendations back to the full committee and to the Governing Board in November.

As a final note on inspections, although insurers can play a role in encouraging property owners to comply with code requirements, the industry cannot take the place of local agencies and the state government in enforcing building code requirements.

Thank you again for the opportunity to submit these comments for the record. We look forward to working with you and other members of the Legislature in the coming year as you examine these and other issues important to the interests of insurers and consumers in California. If you have any further questions please do not hesitate to contact us.

CALIFORNIA  
EARTHQUAKE  
AUTHORITY

RATE MANUAL

OCTOBER 7, 1996





RULE 4. RATING INFORMATION

HOMEOWNERS

A. Dwellings (Except Mobilehomes)

Package premiums are developed using the rates per \$1,000 of Coverage A on the rate page (Section 3) according to the following rating factors:

1. Territory as determined from the Territory Definition Pages (Section 2)
2. Year built
3. Type of Construction material

B. Mobilehomes

Package premiums are developed using the rates per \$1,000 of Coverage A on the rate page (Section 3) for the Territory as determined from the Territory Definition Pages (Section 2)

C. Renters and Condominium or Cooperative

Annual premiums are shown in Sections 4 and 5 by form and coverage. The rating territory is determined from the Territory Definition Pages (Section 2)

RULE 5. HAZARD REDUCTION DISCOUNT

A discount of 5% is applicable to the premium for Homeowners policies and premiums for Coverage A: Real Property and Coverage D: Loss Assessment in the Condominium or Cooperative policy if the following conditions apply:

1. The dwelling/ building was built prior to 1960, and
2. The following construction requirements are met:
  - a. The dwelling is tied to the foundation,
  - b. Cripple walls are braced with plywood or its equivalent,
  - c. The hot water heater is secured to the building frame

RULE 6. ENDORSEMENTS

CEA policies may be endorsed during the policy term only to reflect endorsements made to the member insurer's companion policy. Any additional or return premium will be computed pro rata.



SECTION 3  
 RATES PER \$1,000 OF COVERAGE A  
DWELLINGS AND MOBILEHOMES

HOMEOWNERS BASIC EARTHQUAKE POLICY

RATES PER \$1,000 OF COVERAGE A AMOUNT OF INSURANCE

DWELLINGS (EXCEPT MOBILEHOMES)

FRAME CONSTRUCTION

1979  
 OR  
LATER

1960  
 TO  
1978

PRIOR  
 TO  
1960

ALL  
 OTHER  
CONSTRUCTION

MOBILEHOMES

<u>TERRITORY</u>	1979 OR <u>LATER</u>	1960 TO <u>1978</u>	PRIOR TO <u>1960</u>	ALL OTHER <u>CONSTRUCTION</u>	<u>MOBILEHOMES</u>
01	\$2.70	\$3.30	\$3.50	\$4.80	\$ 7.60
02	4.50	5.50	5.70	7.90	11.85
04	4.00	4.90	5.20	7.10	7.60
05	4.40	5.30	5.60	7.70	11.85
07	2.70	3.30	3.50	4.80	7.60
11	1.50	1.90	2.00	2.70	2.45
12	3.90	4.80	5.10	7.00	
13	1.70	2.10	2.20	3.00	2.45
14	4.50	5.50	5.70	7.90	11.85
15	1.00	1.20	1.30	1.70	2.45
16	2.90	3.60	3.80	5.20	7.60
17	2.80	3.40	3.60	4.90	7.60
18	4.50	5.50	5.70	7.90	11.85
19	4.30	5.20	5.50	7.50	11.85
20	2.40	3.00	3.10	4.30	11.85
21	3.20	3.90	4.10	5.60	7.60
22	4.50	5.50	5.70	7.90	
26	4.20	5.10	5.30	7.40	11.85
27	1.00	1.20	1.30	1.80	2.45



County of Inyo  
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October 22, 1996

Peter Detwiler  
Consultant to the Committee  
State Capitol  
Room 4030  
Sacramento, CA 95814

SUBJECT: PLANNING AND REGULATING FOR SEISMIC HAZARDS

Dear Mr. Detwiler;

Inyo County is one of ten California Counties defined by statute as a "Frontier County." Inyo County has a population of about 19,000 people and approximately 98% of the entire land area is owned by the government. Under almost any definition, Inyo County is a rural County with a population growth rate of less than 1/2 percentage per year.

Inyo County has been hit very hard by state tax revenue shifts from the County to school districts and the state. Meanwhile, Inyo County's revenues continue to decline while state mandated programs are increasing.

If the state is considering legislation to mandate a new process for General Plan Safety Elements, then the state should provide earmarked funding for that purpose. As an alternative, the potential legislation could exempt "Frontier Counties" from the mandate to update the Safety Element.

As a Planner, I want to keep all of the General Plan Elements as current as possible, however, the General Plan has a low local funding priority when compared to criminal justice and health and human services issues. If it becomes state policy to update the Safety Element, then the state should pay for it.

Potential legislation to amend the Subdivision Map Act to address seismic hazards could be very expensive to the subdivider. Any costs associated with the subdivision of property will be passed along to future residents of the subdivision as higher housing costs. Any seismic hazard report would have to be prepared by a registered



California geologist and possibly reviewed by a second geologist. If any on-site work is required, like soil boring or trenching, then seismic hazard reports could be very expensive.

Current law requires seismic hazard elevation for a project located within the Alquist-Priolo Special Studies Zones. Studies required by Alquist-Priolo typically cost thousands of dollars. Do "Frontier Counties" need another mandate that does the same thing as existing law?

Counties have the ability to apply to State Mandates Commission to be reimbursed for funding state mandated programs. This process can take three to five years and could result in claim rejection. It is my opinion, updating the Safety Element may be good state policy for those Bay Area Counties affected by the Loma Prieta event. Requiring "Frontier Counties" to be subject to the same mandates as the Bay Area Counties may not be good state policy because it ignores the fundamental differences between the two groups of Counties to fund mandated programs.

Thank you for your attention to these comments. Please contact me if you have any questions.

Sincerely;



Peter Chamberlin  
Director of Planning  
County of Inyo

cc: DeAnn Baker, CSAC  
Byron Sher, Chairman, Senate Committee on Housing and Land Use

**CALIFORNIA ENGINEERING FOUNDATION (CEF)  
TESTIMONY TO  
HEARING OF  
THE SENATE COMMITTEE ON HOUSING AND LAND USE  
Byron D. Sher, Chairman  
*An Ounce of Prevention: Planning & Regulating for Seismic Hazards*  
October 16, 1996  
San Jose, California**

**INTRODUCTION AND BACKGROUND**

CEF is pleased to respond to the Committee's request to attend and participate in the hearing. Physical attendance at the hearing was not possible, and this document constitutes CEF's input to the hearing process and the printed proceedings.

CEF expresses its appreciation to the Senate Rules Committee for its commendation of CEF for its "*extensive efforts in earthquake hazard mitigation to protect California and the nation against the ravages of earthquakes on people, assets, infrastructure, and the socioeconomic well-being for generations to come.*" This commendation was awarded CEF on August 27, 1996.

CEF was instrumental in the initial technology transfer, over 15 years ago, that resulted in the first use of "base isolation" (one of the design strategies for achieving earthquake hazard mitigation as now defined under law) in a building in America. The building is the Foothills Community Law and Justice Center located in Rancho Cucamonga, California. Since that time, there has been over \$2 billion invested in new and retrofit projects incorporating earthquake hazard mitigation. Nearly all of this has been publicly, not privately, funded.

CEF has, upon request, provided research and policy development counsel concerning earthquake hazard mitigation policy over the past 15 years and is considered an unique source of clinical information on the subject in the country. The testimony provided herein is the product of nearly two decades of research; a two-day national conference on earthquake damage reduction; numerous meetings; a task force on earthquake hazard mitigation; consultations with specialists in engineering, architecture, and policy; and a colloquium on earthquake hazard mitigation policy. CEF's efforts include an in-depth analysis of *the systemic reform of engineering education* with a focus on relevancy of undergraduate education. This is of particular importance in seismic design, since higher levels of seismic protection, including total functionality (earthquake hazard mitigation), includes seismic considerations in the application of the other engineering technical disciplines in building systems (mechanical, electrical, industrial, manufacturing, control systems, etc.) in addition to civil and structural engineering.

The "ounce of prevention" theme of the hearing is apropos. CEF's testimony in the House Science Committee hearings in Congress after the Northridge earthquake stated that in



health care, *an ounce of prevention is worth a pound of cure, but in the earthquake challenge, an ounce of prevention is worth two tons of cure.* When it comes to the loss of life, there is no cure. When it comes to physical damage to structures, building contents or functionality, current seismic design strategy is dictated by the California Building Standards Code which is life/safety only. A manufacturing firm should be advised by their architect and engineer that their \$1 million building that houses \$100 million worth of extremely sophisticated equipment is only designed to prevent collapse, with no protection for contents or function, during an earthquake.

## THE POLICY ENVIRONMENT IN CALIFORNIA AND AMERICA

California is one of the most seismically active states in the continental United States, and that situation has existed for thousands of years. Research has permitted the identification of statistically probable high risk earthquake zones based upon location of active earthquake faults. Unless there is a sudden change in tectonic action, California will remain seismically active for millions of years into the future -- the challenge wont be wished away.

California's Building Standard Code has reduced the number of deaths and injuries associated with earthquakes in contrast to the disasters that have occurred in some less developed nations. Still, California has tens of thousands of buildings which were constructed decades ago and do not even meet the basic life/safety standards of the Building Code, much less *earthquake hazard mitigation* (building structure, contents, and function). Thus, retrofit of existing buildings to bring them up to minimum life/safety standards should be a top priority. In addition, those buildings that have a high contents-to-structure cost ratio and have a high at-risk socioeconomic exposure that warrants continued functionality, should be retrofitted to a higher level of performance than the minimum life/safety requirements of the Building Code.

New buildings should be designed to as high a level of earthquake performance that can be justified by the building owner recognizing the paradigm that drives capital investment in both the public, private, and academic sectors. Under the 1972 Hospital Act, hospitals must remain functional, *as much as practicable*, during and after an earthquake. As was seen during the Northridge earthquake, the law alone will not meet the need. Earthquake hazard mitigation technologies now exist that can significantly improve earthquake performance of buildings and other improvements to real property, including bridges. The rate at which these design strategies will be applied is a matter of policy.

Prior to the 1972 Hospital Act, California's earthquake policy affecting building design was based upon *prescriptive standards*. This means that the Building Standards Code specified how a building would be designed to meet the Code. The Hospital Act introduced "*performance based engineering design*," that is, how a building being used for a hospital should *perform* during and after an earthquake. Designing buildings to a higher level of earthquake protection opens whole new challenges for design

professionals, building owners, buildings developers, and those who occupy buildings on a lease/rent basis.

In 1985, legislation (ACR 55, Rogers) was passed which required the State of California to assess its buildings to determine those that should remain functional during and after an earthquake. In 1989, legislation (SB 920, Rogers) was signed into law (three weeks before the Loma Prieta earthquake) that formalized the whole new field of earthquake hazard mitigation and provided a performance statutory definition under Section 16100 (a) of the Health and Safety Code:

*"Earthquake hazard mitigation technologies" includes, but is not limited to, seismic isolation, energy dissipation, ductility, damping systems, and other technologies which endeavor to reasonably protect buildings and nonstructural components, building contents, and functional capability from earthquake damage.*

The term "technologies" includes, but is not limited to, any design, design strategy, design technique, material, system, manufactured product, device, component, and assemblage of components that contribute to or achieve the performance intent.

The legislation was far reaching. Another provision of the bill resulted in a California Constitutional Amendment (SCA 33, Rogers) which became law in the November, 1990, General Election as *Proposition 127*. This provision removed a policy disincentive to the retrofitting of existing buildings which previously, under the Proposition 13 (real property tax), permitted local tax assessors to reappraise a building in which a major structural change had been made. This could significantly increase the property taxes if the building had not changed hands from the time of original construction. The law carries a "sunset" provision that reestablishes the tax disincentive in the year 2000 if the Legislature does not take action to extend the date.

Only a portion of the SB 920 law has been fully implemented. For example, the Franchise Tax Board has made no attempt to alert design professionals, building owners, building developers, nor local tax assessors about the passage of Proposition 127. As it turns out, there is very little, if any, retrofit taking place, so the potential for property reappraisal is minimal. Assuming that a positive tax incentive policy was established in California and the federal government that stimulated private capital investment in seismic retrofit, the Proposition 127 provisions would take on a whole different level of urgency.

SB 1993 (Calderon) was signed into law September 26, 1996, and created the California Earthquake Authority. California is again in the earthquake insurance business. Tax incentives should be established that stimulate private capital investment in retrofit of single and multiple family dwellings to increase earthquake protection and thus reduce California's loss exposure when the large earthquake hits a highly urbanized area in the state.



Since 1990, additional legislation has been introduced to accelerate the implementation of SB 920 -- the earthquake hazard mitigation law of 1989. This legislation dealt with two fundamental issues affecting the use of earthquake hazard mitigation in new, and retrofit of existing, buildings: **education, and removing capital investment tax disincentives.**

### **Implementing Earthquake Hazard Mitigation Through Education**

The education initiatives, including SB 1490 introduced in 1996, were based upon the following fundamental principles:

1) The President Thomas Jefferson philosophy that educated and informed individuals in a free society are likely to make the right decisions on matters affecting their interests; and that it is better to educate rather than mandate to effect public policy.

2) Ethics of engineers and architects require them to inform their clients (building owners and developers) of critical decision-making issues, such as the limited intent of the seismic provisions of the Building Standards Code and the opportunities that exist to design buildings to a higher level of earthquake protection and performance than just life/safety. There is, however, no legal requirement to do so.

3) Informed decisions by building owners and developers are more likely to further the cause of higher levels of earthquake protection, to the benefit of California, than the current *decision-by-ignorance* strategy, e.g., "build it to Code."

4) Market pressure created by informed clients should stimulate architects and engineers to stay current with the state of the art in building design and thus foster the cause of continued education without the necessity for mandation by government; and,

5) Market-driven need for near term application of new strategies for earthquake hazard mitigation will stimulate engineering and architectural schools to include seismic design in their undergraduate degree programs to prepare design professionals, of all technical disciplines, for earthquake hazard mitigation in California. **Future buildings, and retrofit of existing buildings, must be designed as operating systems not just containment vessels.**

The 1996 legislation to effect the education process, SB 1490 (Rogers), was introduced in several prior legislative sessions from 1990 to 1996. This bill was developed with the assistance many individuals, including, but not limited to:

- \* Seismic Safety Commission,
- \* Director of Seismic Safety Implementation
- \* Division of the State Architect,
- \* Two past State Architects,
- \* State and Consumer Services Agency,
- \* Engineers and architects in California, learned in earthquake hazard

mitigation, who are active members of the various trade and professional organizations, such as: California Council of the American Institute of Architects (CCAIA), Consulting Engineers and Land Surveyors of California (CELSOC), Structural Engineering Association of California (SEAOC), Structural Engineering Association of Southern California (SEAOSC), California Society of Professional Engineers (CSPE), and California Engineering Foundation (CEF).

- \* Individuals from major institutions, such as: California State University, University of California, Pacific Legal Foundation, and Rockwell International.

The bill was a topic of a special day-long forum on earthquake hazard mitigation, sponsored by Senator Rogers and convened at the Long Beach Campus of the California State University, March, 1996. It involved 35 of the state's leaders in earthquake policy, engineering, and architecture. The findings of the forum were incorporated into the bill.

In its final form, the bill merely required architects and engineers to inform their clients of the intended seismic level of protection provided by the Building Standards Code and the fact that there are other design strategies that can improve building performance during an earthquake. The actual wording to be used in the disclosure statement was embodied in the bill to provide uniformity and basis for *standard care*. Providing the written statement to a client satisfied the disclosure requirement. **The bill passed the Legislature but was vetoed by Governor.**

### **Implementing Earthquake Hazard Mitigation Through Tax Policy**

The fundamental principles addressed by legislative initiatives to remove tax disincentives, including SB 1489 in 1996, include:

- 1) Private capital investment of any kind by property owners is heavily influenced by tax and investment policy by the Board of Equalization in California and the Internal Revenue Service of the United States Government.
- 2) The Stock Market (Wall Street) rewards corporations, by raising the price of their stock, when business decisions are made that *reduces cost, transfers assets to liabilities, increases production, and have a near term effect on the profit and loss statement on a quarterly basis.*
- 3) Corporate boards make decisions based upon "*shareholder value*" (stock price) on the near term.
- 4) Long range investment of capital, such as that required for seismic retrofit, by a publicly traded company that does not meet the paradigm of Wall Street will usually cause a reduction in the price of that company's stock, disappointment by the Board of Directors, and personal difficulties for the company Chief Executive Officer.



SB 1489, 1996, was also prepared with extensive research and development. It was the second topic at the Senator Rogers day-long, March, 1996, forum at CSU Long Beach. This bill would have allowed any private capital invested in seismic retrofit of an existing building to be depreciated over a three year period rather than thirty nine years as is current state and federal tax policy. The bill also provided that any "triggering" costs, i.e., those changes that must be incorporated in a building as part of any other structural changes, be included in the total capital outlay for rapid depreciation. This includes such things as facility access called for in the Americans with Disabilities Act (ADA).

The bill was supported by the California Seismic Safety Commission which historically has called for incentives for capital investment in seismic retrofit. It was also supported by engineers, architects, and building owners. The Department of Finance opposed the bill and said that for every \$100 million of capital investment made for seismic retrofit, the state would lose \$2 million in tax dollars if it were depreciated in three years (as the bill provided) instead of thirty nine years according to present state and federal tax policy.

Senator Rogers requested a special study by the Senate Office of Research (S.O.R.) to determine the amount of voluntary, private sector-financed, seismic retrofit taking place in California. Data were obtained from the building departments, based upon issued building permits, of ten cities and counties in California. The S.O.R. report concludes:

*"According to our survey, relatively few voluntary seismic retrofits are taking place in California, with most retrofit projects occurring on single-family dwellings as a result of local government public education programs. Very little voluntary commercial retrofit activity is occurring. Most commercial activity is because of mandatory local programs to strengthen, demolish or reduce occupancy of unreinforced masonry buildings or as a result of earthquake damage."*

The S.O.R. report was provided to the Senate Revenue and Taxation Committee to demonstrate that there was little or no retrofit taking place, and thus, rapid capital recovery would have no negative impacts on the state revenue but actually would generate taxable cash flow that would actually increase state tax revenues

Written testimony was also obtained by Senator Rogers from the Principal Economist (now retired) of the World Bank, a copy of which is attached. Paraphrasing Dr. Robert Myers' testimony:

*I understand that the California Department of Finance is opposing SB 1489. It is my impression that the Department's opposition is based upon the narrow, tax risk-averse and essentially incorrect grounds that it would result in short-term, annual, gross revenue "losses" of \$2 million per \$100 million of seismic retrofit investment. This figure is most likely incorrect, but, more importantly, not a relevant one from the point of view of designing good tax policy. Viewed*

*in a more socially responsible light, SB 1489 (favoring faster depreciation) is most likely to increase the levels of investment, the size of the tax base, and the longer term tax take from the California economy. This has been our experience elsewhere when initial conditions, similar to those in California, that is, depressed levels of and incentives for investment, exist.*

The bill was defeated in the *Senate Revenue and Taxation Committee* as urged by the *California Department of Finance*. Senator Rogers discovered that the Department uses a static, rather than a dynamic, model for analyzing tax related legislative initiatives. In addition, the Department assumes that the investment would have been made without the stimulus of rapid write-off.

### LESSONS LEARNED FROM THE NORTHRIDGE EARTHQUAKE

There have been several reports prepared on "lessons learned" from the Northridge. CEF was asked to, and did provide written testimony in the hearings of the House Science Committee in Congress in March, 1994. In addition, the following observations deal with cogent policy issues:

\* **The current Building Standards Code is not adequate for the protection of California's overall socioeconomic interests under the continuous threat of earthquakes.**

The Building Standards Code deals with life/safety exclusively. The 1996 Accumulative Supplement of the Uniform Building Code, Chapter 16, Section 1624.1 Purpose reads: *The purpose of the earthquake provisions herein is primarily to safeguard against major structural failures and loss of life, not to limit damage or maintain function.* Had the earthquake struck during working and commute hours instead of 4:30 AM, and had the day been a work-day rather than holiday, the loss of life and human suffering would have been much greater. The actual immediate physical losses were large, (estimated to be between \$20-30 billion) and the socioeconomic losses transcend the physical damage. A significant portion of the physical damage done to buildings, their contents, and function is still undocumented. Add to this the loss of production and market share of manufacturing firms, and the loss of enterprise by the closing or relocation of businesses, both within and outside of California.

From a functional perspective, the children's wing of the Los Angeles County Hospital became dysfunctional because of broken water lines in the building. This occurred even though the 1972 Hospital Act states that Hospitals must remain functional after an earthquake.

\* **Little, if any, private sector capital investment is being made in seismic retrofit of buildings that were damaged by the Loma Prieta and Northridge earthquakes.**



This fact was documented by research conducted by the S.O.R. May, 1996, for Senator Rogers in conjunction with SB 1489.

\* ***Building owners and occupants are not informed about the limited protection of seismic provisions of the California Building Standards Code.***

After the Northridge and Loma Prieta earthquakes, a common statement being made was, "why didn't someone tell me." Under existing law, the seller of real property is required to disclose to a potential buyer the earthquake-resistant or deficiency of the building being sold. However, there is no law that requires architects or engineers to tell their clients the level of earthquake protection (life/safety only) that is intended by the Building Standards Code.

\* ***Fear of increased liability by some design professionals and building owners transcends the need for promoting a higher level of protection to buildings, their contents, and function than that provided by the minimum seismic requirements of the Building Standards Code.***

Nearly all of the opposition to legislation that would have promoted the education of building owners and developers by their engineers and architects was based on a perceived possible increased liability of design professionals. This fear emanates from two possible scenarios:

1) Designing to a higher level of earthquake protection (performance code) than that required by the minimum life/safety provisions of the current Building Code (prescriptive code) is more difficult to defend in court when there is a law suit prosecuted because of earthquake damage.

2) Informed clients would ask their engineers and architects to design to a higher level of performance once they knew of the very limited seismic protection intended by the Building Standards Code. If the engineer or architect was not current with the state of the art in providing a higher level of protection and only knew how to design to minimum Code, they would lose their client to a design professional who is current. In this latter case, an engineer would be in violation of "**Rule 415**" of the *Board of Registration for Professional Engineers and Land Surveys* if they offered to practice outside of their field of competence.

\* ***There is no earthquake hazard mitigation constituency in California. Thus, legislation that is for the good of the public (pro bono publico) has a difficult challenge in being adopted if there is any vested interest opposition.***

There is a plethora of organizations involved in different aspects of the earthquake challenge. Designing a building, or other improvement to real property, in which the desired level of protection exceeds the minimum life/safety requirements of the Building Code, becomes a systems challenge that must be addressed holistically. Where

building contents, structure, and functionality preservation is desired, all of the various technical disciplines of architecture and engineering must be applied synergistically. This is a major deviation from the current approach. CEF has historically taken a systems perspective on earthquake hazard mitigation.

**\* California must establish a strategic policy on earthquake hazard mitigation. Education, positive incentives for building owners to invest the additional capital needed for new, and retrofit, construction, and removal of policy impediments must be the highest priority.**

With the exception of the Field Act (schools), Hospital Act of 1972, and the Critical Services Act of 1986, California has no strategic policy to promote higher levels of building earthquake performance, such as those included in Section 16100 of the Health and Safety Code (protection for structure, building contents, and functionality). Such a policy must be fostered by the highest level of government and be backed by the public, private, and academic sectors.

**\* Retrofit of existing buildings must be a top priority. Strong incentives, both financial and political, must be applied to incorporate earthquake hazard mitigation in new construction where applicable, since the differential cost is small, but the "insurance value" is very high.**

Current tax policy permits expensing earthquake insurance premiums and losses associated with earthquake damage the tax year in which the action is effected. However, the extra capital required (estimated to be up to 5% of the construction cost of a new building over that of one designed to the minimum life/safety requirements of the Building Code), can only be depreciated over a period of 39 years. **From a tax perspective, earthquake hazard mitigation should be looked upon as the buying of a whole life policy with the initial premium being paid in full at the time of construction.**

**\* Performance based engineering design has the greatest potential for pushing higher levels of protection for buildings and other improvement of real property, including earthquake hazard mitigation strategy (full functionality). By their nature, prescriptive codes require a long certification procedure, and once in place, become impediments to the use of new design strategies in building design.**

## **SUMMARY AND CONCLUSION**

Senator Don Rogers has championed the earthquake hazard mitigation cause over the past 17 years. His retirement at the end of the 1996 legislative session leaves a void in the Legislature. Additionally, Senator Rogers efforts have been pro bono publico, and there is no political constituency for earthquake hazard mitigation in California. The most profound lesson to be learned from the Loma Prieta and Northridge earthquakes, together



with efforts to move ahead a mitigation strategy, is that an ounce of **mitigation** (prevention) is worth two tons of cure.

Thus, earthquake hazard mitigation must become top California policy with commitment emanating from the Governor's office. Federal policy for natural disasters has been established by the White House when FEMA was directed to, and did, establish its Division on Natural Disaster Mitigation. Without a demonstrated, comprehensive, policy backed by a strategic plan and a manifest commitment and demonstrated action by the highest elected official in the state, California's earthquake policy, beyond the fundamental life/safety mission, will continue to focus on state and federally-backed insurance-funded repairs.

When it comes to earthquakes, it is not a matter of "if," only when, where, how big, and the level of damage. The U. S. Geological Survey (USGS) predicts a 90% chance of a large earthquake in the Santa Clara area in the next 30 years. This will be an immediate \$100 billion disaster, and insurance will cover only a small fraction of the immediate damage and little or none of the socio-economic consequences that will follow. Nonetheless, facing this reality, the City of San Jose has decided to build its new \$69 million technical museum to the seismic requirements of the Building Standards Code only.

Now is the time to act, and policy, education, research, technology, and technology transfer must become the driving force. CEF is committed to this mission.

Note: For additional background, research, and other information, including the *National Center for Earthquake Hazard Mitigation*, interested parties may contact: **Robert J. Kuntz, Sc.D., P.E., President.**

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**Attachment: EXPERT WITNESS TESTIMONY on SB 1489 BY DR. ROBERT MYERS, Principal Economist, The World Bank**

10/25/96 seismic\stmmny96.doc

**EXPERT WITNESS TESTIMONY**

**BY DR. ROBERT MYERS**  
**Principal Economist**  
**The World Bank**  
**Support for California Senate Bill SB 1489**  
**1996**

This testimony is advocating, with reasons, the passage of California legislative bill, SB 1489, which proposes more rapid (three-year) tax depreciation allowances for earthquake hazard mitigation investments to increase protection for job and wealth-generating physical assets. I am an American Economist, concerned with increasing America's international competitiveness and productive employment. Earthquakes have the ability, in a very short span of time, to injure or kill people, destroy buildings, break or destroy building contents (including highly sophisticated manufacturing systems), and render facilities completely disfunctional all of which have a negative impact on the health and wealth of our nation.

The most important reason for passing this tax reform bill is that it is a small part of a series of tax reforms which are desperately needed in the U.S. if we are to stimulate the amounts and types of capital investment required to provide productive jobs and a robust tax base.

I deal continually with issues relating to tax reform and the impact of taxes on investment incentives in developing countries. Some, such as the East Asian ones, and lately Mexico, have, by taking some short term tax revenue "risks," reaped large, longer term tax benefits by granting more favorable investment tax treatment, including faster depreciation allowances. Others, such as certain South Asian, Eastern European and African countries, as well as most of the states of the U.S., have been so tax revenue risk-averse that they are squeezing the existing tax base too hard and stifling investments which will provide them with more productive jobs and tax revenue.

I also would like to reference two World Bank publications on Tax reform which make the point that reforms to the tax system are least risky when taken in an integrated fashion while following a principle of revenue neutrality

*Lessons of Tax Reform*, The World Bank, Washington, DC, September 1991; and

*Cash Flow of Income? The Choice of Base for Company Taxation*, by J. M. Mintz and J. Seade, World Bank Working Paper # 177, April, 1989

The authors support the view that more rapid depreciation schedules, up to and including full expensing or "cash flow" taxation, are desirable as a means of stimulating capital investment, thus strengthening the tax base.



I understand that the California Department of Finance is opposing SB 1489. It is my impression that the Department's opposition is based upon the narrow, tax risk-averse and essentially incorrect grounds that it would result in short-term, annual, gross revenue "losses" of \$2 million per \$100 million of seismic retrofit investment. This figure is most likely incorrect, but, more importantly, not a relevant one from the point of view of designing good tax policy. Viewed in a more socially responsible light, SB 1489 (favoring faster depreciation) is most likely to increase the levels of investment, the size of the tax base, and the longer term tax take from the California economy. This has been our experience elsewhere when initial conditions, similar to those in California, that is, depressed levels of and incentives for investment, exist.

SB 1489 will help foster the inculcation of updated or newer "vintage" technology into existing buildings through seismic retrofit. Finally, it will improve the "malleability" or loss resistance of newly undertaken investment. These last two will, together, provide more "insurance" against sharp tax revenue declines in the event of future, natural (earthquakes) economic "shocks."

This last, or "insurance" benefit derivable from SB 1489 is a significant one. The Government of California has a responsibility to provide steady flows of "social" goods and services to its citizens by maintaining the revenue-earning potential of its tax base over the long run, as well as in the event of the occurrence of sudden negative economic "shocks" like those created by a seismic event. The latter is an insurance issue and is the focus of the bill. In some respects, SB 1489 can be viewed as a facility life-time, full-coverage, insurance policy in which the premium is paid up-front. Loss prevention is a more effective strategy over damage restitution and aligns directly with the new mandate of the Federal Emergency Management Agency (FEMA) that states that "mitigation" is the cornerstone of natural disaster policy.

The January 17, 1994, Northridge earthquake significantly disrupted the tax base in the effected region and the ability of the state to maintain its investment climate. A portions of California's capital base was "ossified" and non-malleable so that it was destroyed and/or became useless after the earthquake. The question is, having failed this time, what should California do differently in order to avoid a recurrence in the future? There are two options.

1) The State can increase public expenditures in order to buy insurance (e.g., from the Federal Government). In this case, there would be increased certainty regarding social expenditures (consumption) in the future, but the investment and jobs financed by California's insurance premiums would accrue to other states.

2) The alternative is to give tax breaks (faster depreciation allowances) to stimulate "shock-proofing- types" of investments (seismic retrofit). If one assumes that the investment in seismic retrofit would have been made without the tax incentive, there may be reduced near-term tax income, but California gets new investment and jobs and a

larger, more "shock-resistance" tax base in the medium and longer term. However, in the case of earthquake hazard mitigation, past history indicates that this area has not experienced new capital flow, and the assumption that the capital would have been invested in seismic retrofit without the tax incentive is of no relevance. Either way, SB 1489 is tax revenue-positive with the added socioeconomic benefit of productive asset preservation.

In closing, I would like to deal with the "if it ain't broke, don't fix it" sentiment which our (*The World Bank*) risk-averse client countries exhibit when facing recommendations for tax reform. The truth is, California's tax system is "broke" --seriously so. The only situation in which SB 1489 reform bill will result in true, longer term tax revenue loss is when it is introduced into a "best of all worlds" or optimal tax regime, very unlike what exists in California and in the U.S. today. In a perfect tax regime, investors would already be stimulated to maximize real, productive investment, of the sort which insulates them from economic "shocks" and, only then, SB 1489 could be seen as an unnecessary "gift" to investors.

However, California's tax system is far from perfect when compared with the truly dynamic economies of the world. In those countries, a much larger share of taxes are collected from *consumption expenditures*, and depreciation schedules are very rapid. As a result, the countries with these tax policies are attracting larger amounts of "shock-proof" investments with the benefits they provide in job growth and wealth generation.

I would appreciate being kept informed as to the status of SB 1489 as it moves through the legislative process. I hope that success of this legislation in California will be followed by an initiative in Congress to revise the Federal IRS Code in like fashion.

Dr. Robert Myers  
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